AN ARIHANT POCKET BOOK

FORMULAE & DEFINITIONS IN

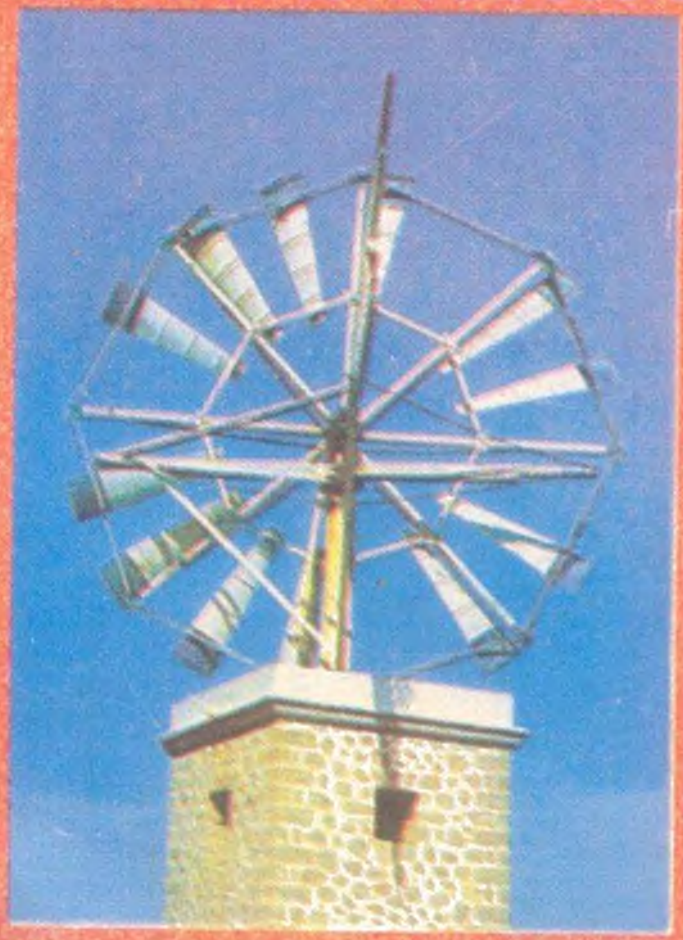
SCIENCE

(TEXT-BOOK QUESTIONS SOLVED)

X

NCERT REVISED SYLLABUS

CBSE SAMPLE PAPERS SOLVED



According to New Syllabus of NCERT and CBSE (All India Board) based on New Education Policy

FORMULAE & DEFINITIONS IN
SCIENCE

Class X

NEW 4 CHAPTERS AS PER REVISED SYLLABUS 1992-ALSO ADDED

CBSE SAMPLE PAPERS SOLVED

ALL NCERT TEXT-BOOK QUESTIONS-SOLVED

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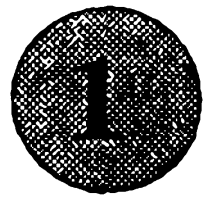


ENERGY

1.1. Energy. When an object is capable of doing work it is said to possess energy. Energy is defined as the capacity of a body to do work. The amount of energy possessed by a body is equal to the amount of work it can do when its energy is released.

1.2. Various forms of energy. The various forms of energy are :

1. Mechanical energy
2. Chemical energy
3. Electrical energy
4. Thermal energy

1.3. Forms of Energy which ancient man used. In ancient days and even today man has been using the energy stored in the muscles of his body. The source of this energy is the food that he eats.

Apart from this man uses the animal energy to perform heavier tasks, *e.g.* the pyramid of Giza in Egypt was built by men and animals using their energy in the muscles.

1.4. First external source of energy used by man. The first external source of energy used by man was fire. It was used for cooking food, heating and lighting. Wood was initially the only fuel, later on man discovered deposits of asphalt, peat and coal.

1.5. Simple machine. A machine is a device by which we can overcome a greater resistance (load) by applying a small force (effort) at a convenient point and in a desired direction, or to gain a speed.

The simple machines or basic machines are the lever, the pulley, the inclined plane and the screw.

1.6. Use of Simple machine in mechanical task. Let us consider the use of lever to perform the task of lifting a 500 kg stone. The efforts required to lift the stone directly by the muscle power is 500 kg. But when the lever is used as shown in Fig. effort of only 100 kg is required.

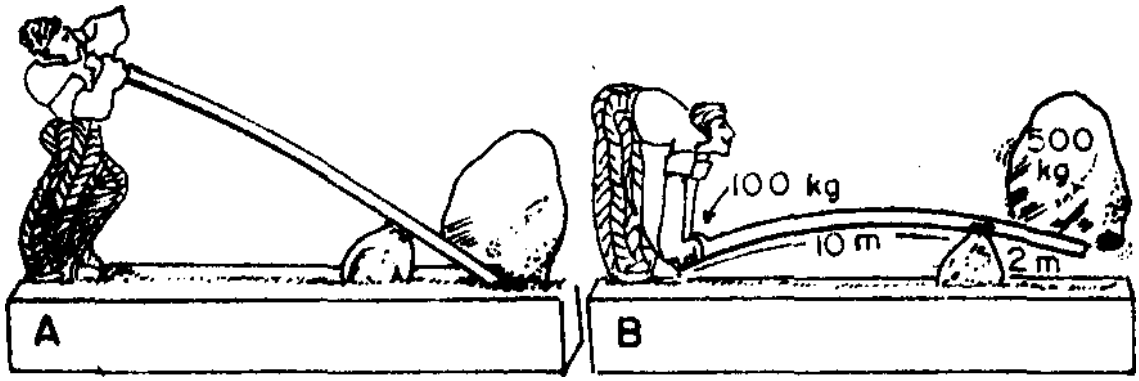


Fig. A lever being used to lift a mass of 500 kg.

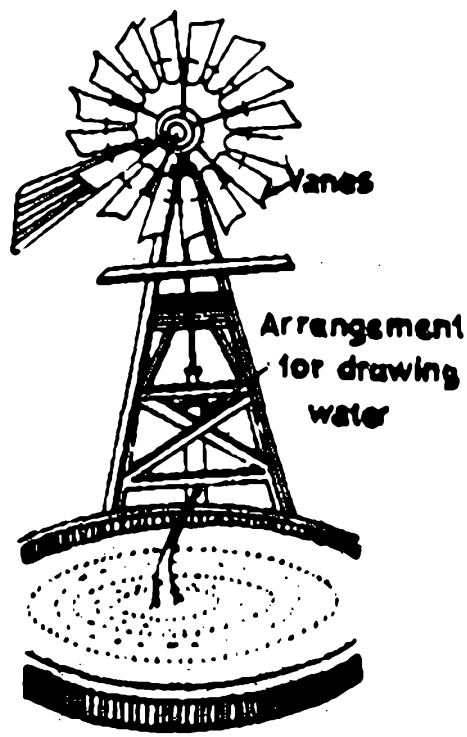
Here, effort P = 100 kg, Distance, D = 10 m and Load, W = 500 kg, d = 2 m

We find that input = output

$$P \times D = W \times d$$

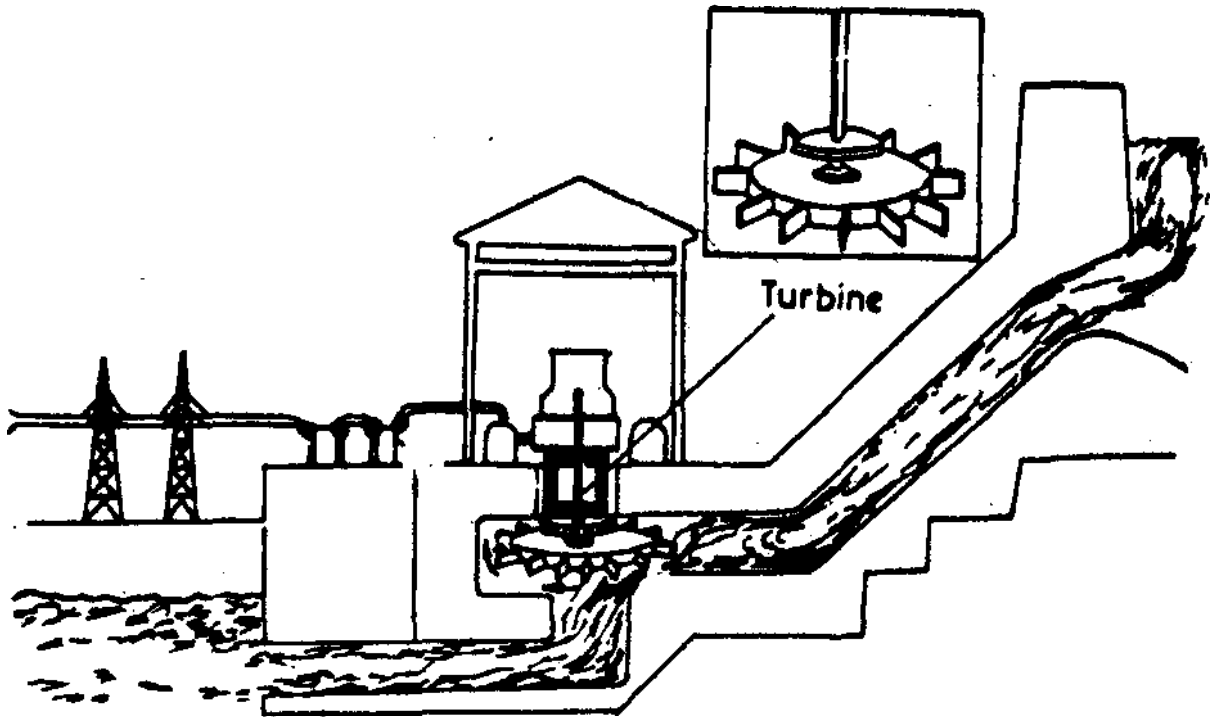
This means that machines only reduce the efforts needed to perform mechanical tasks but do not themselves provide the energy to do the task.

1.7. Uses of wind (moving air) energy. A sail boat uses this kinetic energy of the wind to propel itself in the direction of the wind instead of the energy in muscles to row it. The energy in the wind can rotate the blades of a windmill, which can be suitably connected to simple machines. Hence wind energy may be used to perform mechanical work such as, to move heavy stones, to grind corn and wheat, or for pottery, mining and metallurgy.



1.8. Uses of water wheels. Flowing water has kinetic energy by virtue of its motion, this gives it the ability to do work. The flowing water can rotate blades of the water wheel. This motion can be passed on to other connected parts. Initially the energy was used to move heavy stones to grind corn and wheat. Now-a-days, the flowing water is stored behind dams and the potential energy is used

to produce electricity. It can also be used in rotating the wheel for pottery or mining and metallurgy.



1.9. Limitation of water and wind energy. The major limitations are :

(*i*) The flowing water and wind are not found everywhere.

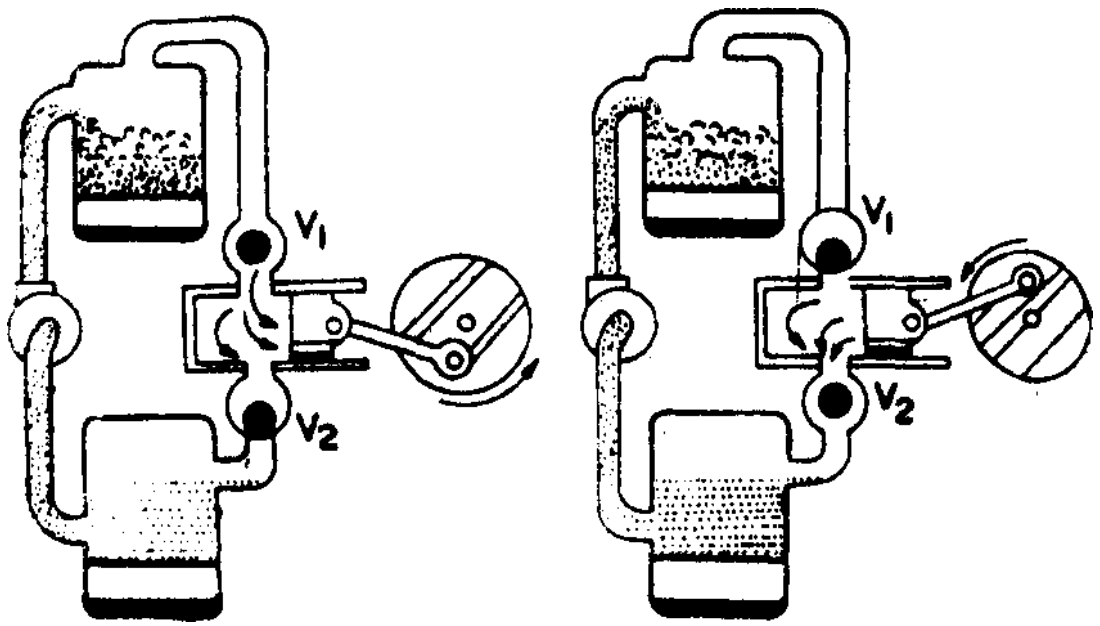
(*ii*) Useful work can be performed only at the site where the wind or watermill is installed.

1.10. Engine. Engine is a practical device which transforms heat energy into the mechanical energy.

1.11. Working of External Combustion Engine. Fig. shows Simple steam engine. Steam produced in the boiler (outside the cylinder, hence called external combustion engine) is allowed to enter the cylinder through a valve which pushes the piston in the forward direction. The piston is connected to the arm of a suction pump or to a crankshaft of a wheel of an automobile or train.

Expansion stroke. Fig. (*a*) shows the expansion stroke in which valve V_1 opens and stream from the boiler enters the cylinder which exerts the pressure on the piston and the piston moves forward and it rotates the wheels through crank shaft. In this stroke valve V_2 remains closed.

Exhaust stroke. In this stroke valve V_1 remains closed while V_2 opens and the piston moves forward and it pushes the remaining steam outside the cylinder. The cycle repeats and the to and fro motion of the piston is converted into circular motion of the wheel. This type of engine was first used to pump



(a) Expansion Stroke *(b) Exhaust Stroke*

water out of deep pits and flooded mines. This engine can be located anywhere and can be fitted in vehicles and steam engine.

1.12. Limitations of External Combustion Engine.

(1) High pressure of steam can cause the boiler to burst.

(2) These are bulky because of boilers and cannot be used in small sized automobiles.

(3) The surface area of boiler is very large hence large amount of heat energy is lost due to radiations so the efficiency is low.

1.13. *Principle of Internal Combustion Engine.* In an internal combustion engine a small amount of fuel is let into the cylinder and ignited. This combustion converts the liquid fuel into gases, these expanding gases pushes the piston outwards. Proper arrangements are made to exhaust the cooled gases and allow fresh fuel to be injected, and the cycle is repeated as long as desired.

1.14. Working of Internal Combustion Engine. The mixture of fuel and air is let into the cylinder in the intake stage *A*. This mixture is then compressed by the moving piston in the compression stage *B*. At the proper time when the piston is about to reach its maximum position of compression a spark is produced in the spark plug which ignites the mixture stage *C*. The ignition generates lot of heat which expands the gases and these gases push the piston outwards in the expansion stage *D*. Finally, the exhaust valve opens to let out the cooled gases in the exhaust stage *E*. The piston once again moves upwards and the cycle of five stages is repeated. The mechanism that connects the piston to the rotating wheel is the crankshaft.

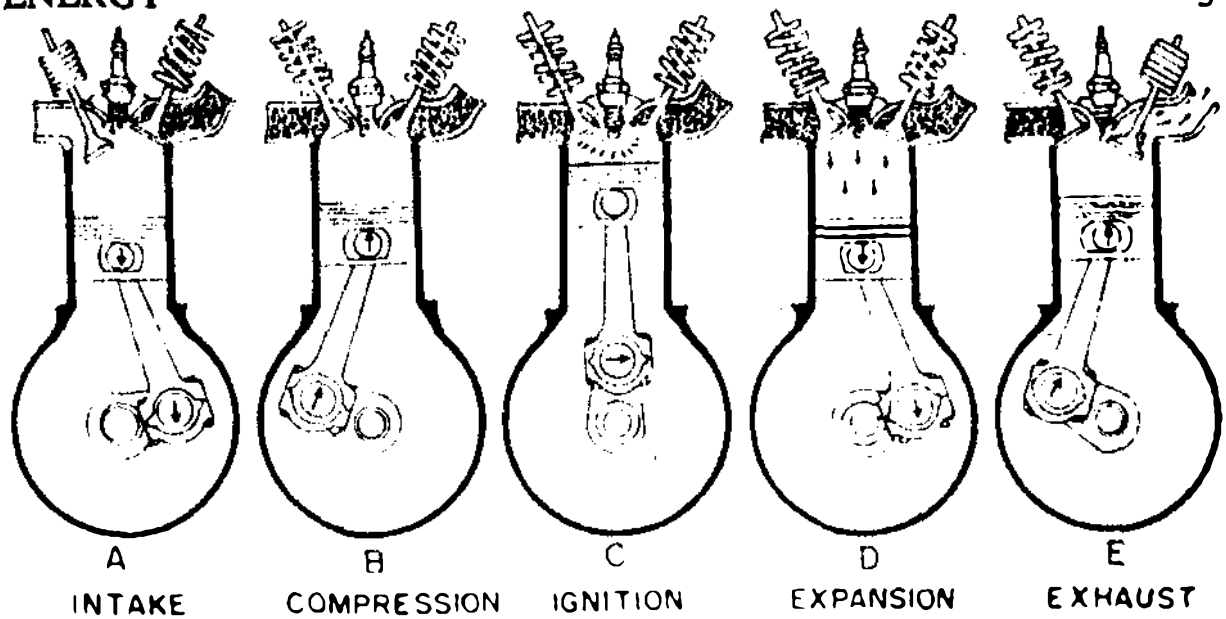


Fig. A schematic drawing of an internal combustion engine

1.15. Power. Power is defined as rate of doing work

$$\text{Power, } P = \frac{\text{Work done}}{\text{Time taken}} = \frac{W}{t}$$

Power is a scalar quantity.

1.16. Unit of Power. Unit of power is watt.

$$1 \text{ watt} = \frac{1 \text{ Joule}}{1 \text{ second}}$$

or

$$1\text{W} = \frac{1\text{ J}}{1\text{ s}} = 1 \text{ Joule per second.}$$

The bigger unit of power is kilowatt

$$1 \text{ Kilowatt} = 1000 \text{ W}$$

$$1 \text{ Horse power} = 746 \text{ watts.}$$

1.17. Law of conservation of energy. It states that whenever energy changes from one form to another the total amount of energy remains constant, *i.e.* energy can neither be creased nor destroyed.

1.18. Mechancial equivalent of heat. The amount of heat produced is directly proportional to the amount of work done. Both heat and work done are measured in Joules. If W Joules is the work done and H calories of heat is produced, then

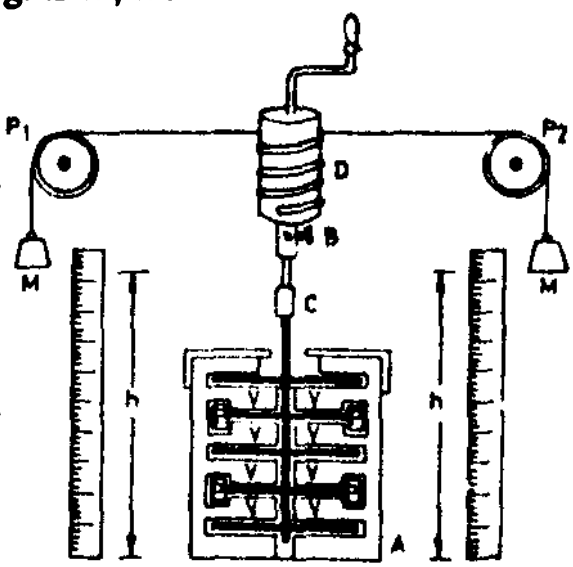
$$W \propto H$$

$$W = J\,H.$$

Here J is constant and is known Joule's constant of mechanical equivalent of heat J may be defined as the amount of work required to be done to produce a unit quantity of heat. The value of heat is 4.18 Joules/cal.

1.19. Joule's experiment for determintation of J. Joule performed an experiment for measuring the mechanical equivalent of heat. The apparatus used by him is shown in Fig.

The apparatus consists of a copper cylinder C fitted with vanes V as shown in the figure. The stirrer consists of a spindle S fitted with a set of paddles P. The upper end of the spindle is connected to a drum D. Two strings are wound round the drum which pass over two frictionless pulleys. The free ends of these strings are attached to two equal weights W, W.



The cylinder contains a known amount of water whose temperature is noted. When the weights are allowed to fall, the spindle turns and the paddles produce a churning motion of the water inside the cylinder. The potential energy of the weights is converted into the kinetic energy of water. The motion of water is prevented by the vanes and thus the kinetic energy of water is converted into heat energy, which raises the temperature of water. The energy that weights lose as they fall is the potential energy (mechanical energy). The energy that raises the temperature of water is the heat energy. All the potential energy is thus converted to heat energy. It was found that when the falling weights lost 4186 Joules of mechanical energy, the temperature of 1 kg of water raises by 1°C. If the experiment is repeated several times, the same result will be obtained everytime.

Q. 1. Give three uses of wind energy, water wheels and solar energy.

Ans. Uses of Wind Energy.

The kinetic energy of the wind can be used for

(*i*) rotating the blades of a wind mill and thus can be used for (*a*) pumping water from the wells; (*b*) generating electricity (*c*) running flour mill.

(*ii*) propelling the sail boats.

Uses of Water Wheels.

The flowing water has kinetic energy, by the virtue of which it can do mechanical works. The flowing water can rotate the blades of a water wheel. This motion of the water wheel through proper combination with some machines, can be used for

(*i*) producing electricity
(*ii*) moving heavy stones
(*iii*) running flour mill
(*iv*) grinding

Uses of the Solar Energy.

One third of the total solar radiation falling on earth is infra-red radiation. These radiations heat up the object on which they fall. This thermal and visible light emitted by the sun can be used for

(*i*) heating purposes through the use of solar heaters.
(*ii*) cooking purposes through the use of solar cookers.
(*iii*) generating electricity through the use of solar batteries.

Q. 2 State the advantages of the internal combustion engine over wind mill.

Ans. An internal combustion engine has the following advantages over wind mills :

(*i*) It occupies less space as compared to the wind mill.

(*ii*) It has high thermal efficiency about 40% compared to ≈ 7% for wind mill.

(*iii*) It can be used anywhere under all conditions. Wind mill can be used only at places where the wind flow is plentiful.

(*iv*) Internal combustion engines are used in vechicles, while wind mills cannot be used in vehicles.

(*v*) The energy of wind is too small to lift great quantity of water mines and wells. While internal combustion engine can lift great quantity of water in very less time.

Q. 3 An engine is designed to convert 40 % of heat energy into work. If the steam engine has 50,000 J of energy how high would this engine lift a weight of 1 kg from the ground ?

Ans. The steam engine is designed to convert 40% of heat energy. It has 50,000 J of energy, thus the amount of work it can perform is 40% of 50,000 J.

Therefore work done by the engine

$$= \frac{40}{100} \times 50,000\ J = 20,000\ J$$

As the weight of 1 kg is lifted it gains potential energy. Let the height to which it gets lifted be h, such that at that height it has the 20,000 J of energy as potential energy.

Therefore $\quad P.E. = mgh = 20,000\ J$

$$h = \frac{20,000}{mg} = \frac{20,000}{1 \times 9.8}$$

$$= 2040.8 \text{ metres (approx)}$$

The engine can raise it to a height of 2040.8 m from the ground.

Q. 4 We have seen that the external combustion engine has many advantages over the internal combustion engine. Can you think of one disadvantage ?

Ans. Disadvantage of External Combustion Engine. External combustion engine consists of a boiler in which water is boiled and converted into steam at a very high pressure, to get maximum mechanical work. High pressure may cause boiler to burst. External combustion engines are very bulky due to boiler and hence cannot be used in small vehicles like car, scooter etc.

Q. 5 An engine supplies 10,000 joules per minute. What is the power supplied ? Express the total energy supplied by one kilowatt hour (kWh) of power in an hour ?

Ans. By definition, power is the rate at which energy is supplied. In this case 10,000 joules is supplied in one minute = 60 seconds.

Therefore, $\quad \text{Power} = \frac{10,000}{60}$ Joules/sec

$$= 166.67 \text{ watts.}$$

Energy supplied by a power of 1 kWh in one hour is equal to (Power and Time)

Hence, $\quad \text{Energy} = 1 \text{ kilo-watts} \times 1 \text{ hour}$

$$= 1000 \text{ watt} \times 1 \text{ hour}$$

$$= 1000 \times \frac{\text{Joule}}{\text{sec.}} \times 60 \times 60 \text{ sec}$$

$$= 3600000 \text{ Joules}$$

$$= 36 \times 10^5 \text{ Joules}.$$

Q. 6 Electrical energy consumed in your house is measured in kWh. Find the total kWh consumed in your house in a month by reading the number of units on your electricity bill (one unit = 1 kWh). If 1 unit of energy goes into heating 10 litre of water what would be the increase in its temperature ?

Ans. Let us suppose that in electricity bill, the number of units consumed in a month is 150 units. It means that in a month 150 kWh electrical energy has been consumed.

1 unit = 1 kWh = 1000 watt $\times$ 60 $\times$ 60 J = 36×10^5 J

Mass of 10 litre of water $m = 10$ kg

4186 J of work produces that much heat which can raise the temperature of 1 kg of water by 1°C.

Let the increase in temperature of water = t°C

$$\text{Heat taken by water} = m \times \text{sp. heat} \times t$$

$$= 10 \times 4186 \times t$$

$$10 \times 4186 \times t = 36 \times 10^5$$

$$t = \frac{36 \times 10^5}{10 \times 4186} = 86°\text{C}.$$

Q. 7 One gram of coal when burnt can provide 350 J. How many tonnes of coal would you need to provide as much energy as shown in the electricity bill of your house hold ?

Ans. Let electricity consumed in a month = 150 units

$$= 150 \quad \text{kWh}$$

$$= 150 \times 1000 \times 60 \times 60 \text{ J} = 150 \times 36 \times 10^5 \text{ J}.$$

350 J heat is produced when 10^{-3} kg coal is burnt

Hence $150 \times 36 \times 10^5$ J heat would be produced

or Burning coal $= \dfrac{10^{-3} \times 150 \times 36 \times 10^5}{350} = 1.542 \times 10^3$ kg

$= 1.542$ tonnes of coal.

Q. 8 If each one of us used up the above amount in a month, how long would the reserve of coal in India last. You can assume that the population of India is exactly 800 million and that India has exactly 80 billion tonnes of coal reserves. These numbers are not far from the real quantities.

Ans. As in above question, consumption of coal per family = 1.542 tonnes

Population of India = 800 million = 800×10^6

Coal reserves in India = 80 billion tonnes = 80×10^9 tonnes.

Hence, coal reserve per person = $\dfrac{80 \times 10^9}{800 \times 10^6} = 100$ tonnes.

Coal reserve per family (of 5 members) = $100 \times 5 = 500$ tonnes. Now 1.542 tonnes of coal is used by a family in 1 month. Hence 500 tonnes of coal will be used in

$= \dfrac{500}{1.542}$ months

$= 324.2$ months

$= 27$ years.

Q. 9 For one unit of electricity (one kWh) you can

(*a*) Burn a 100 W bulb for 10 hours

(*b*) Operate a fridge for a whole day

(*c*) Run an electric mixture for two hours

(*d*) Operate a TV set for six hours

(*e*) Make 70 slices of toast

(*f*) Listen to the transistor radio for 1000 hours

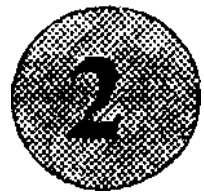
(*g*) Heat an electric stove for 30 minutes.

From this information can you calcualte the number of units your family would need in a month ? If you had to reduce the units consumed, which of the above would you reduce ?

Ans. In order to calculate the approximate number of units needed by our family in a month, we will make the following calculations.

S. No.	*Information*	*Approximate consumption in a day*	*Approximate consumption during a month*
(*a*) Bulb	100 W bulb × 10 hours = 1 unit	5 bulbs × 5 hr × 100 W = 2500 W hour = 2.5 kWh	2.5 kWh × 30 = 75 kWh
(*b*) Fridge	Whole day operation = 1 unit	1 kWh	30 × 1 kWh = 30 kWh
(*c*) Electric mixture	Two hour operation = 1 unit	$\frac{1}{4}$ hour per day = $\frac{1}{4}$ kWh	$30 \times \frac{1}{4} = 7.5$ kWh
(*d*) T.V. Set	6 hour operation = 1 unit	3 h operation = $\frac{1}{2}$ kWh	$30 \times \frac{1}{2} = 15$ kWh
(*e*) Toaster	70 slices = 1 unit	14 slices per day = $\frac{14}{70} = \frac{1}{5}$ kWh	$30 \times \frac{1}{5} = 6$ kWh
(*f*) Transistor	1000 h operation = 1 unit	2h operation = $\frac{2}{1000}$ kWh	$30 \times \frac{1}{500} = 0.06$ kWh
(*g*) Electric stove	$\frac{1}{2}$ h operation = 1 unit	1 hour operation = 2 kWh	30 × 2 = 60 kWh
		Total electricity consumed	= 193.56 kWh = 193.56 units

We find that operation of one electric stove for 1 hour per day consumes 60 units of electrical energy per month, which is maximum rate of consumption among all electrical appliances, hence Electric stove must be operated less to reduce Electric bill.



FUELS

2.1. **Fuel.** A material or substance, that burns to provide energy, is called a fuel, *e.g.*, wood, coal, petrol, kerosene, diesel, liquified petroleum (LPG), solar energy and nuclear energy are new sources of energy.

2.2. **Biomass.** Biomass is the material present in bodies of plants and animals. When plants and animals die, their biomass can be used as a fuel. In rural areas, domestic energy needs are met mainly from biomass like wood, agricultural wastes and animals dung cakes, vegetable refuse, etc. They can also be used in industries, *e.g.*, sugarcane remains after extracting juice from it, is used as an industrial fuel

2.3. **Hazards of using conventional sources of energy.**

(*i*) Wood is burnt in traditional chulhas. The efficiency of burning wood in such chulhas is very poor (10 to 18%). Due to incomplete combustion, wood produces gases like carbon monoxide, which are dangerous for our health.

(*ii*) Animal dung is, usually, made in the form of cakes, dried in air and then burnt for domestic purposes. Since animal dung is burnt inefficiently, it produces a lot of smoke, which is harmful for health. Moreover, burning of animal dung amounts to wastage of many useful elements contained in it, besides producing air pollution.

(*iii*) Agricultural wastes like sugar-cane, when burnt, also amounts to wastage of useful elements, besides producing air pollution due to incomplete combustion.

2.4. **Destructive distillation of wood.** When wood is burnt in an insufficient supply of air, volatile matter in the wood is driven off and a residual mass called charcoal is left behind. This process is called destructive distillation of wood. On an average 25% of charcoal is produced from wood.

2.5. Characteristics of ideal fuel.

1. An ideal fuel should have high calorific value.
2. It should be cheap and readily available.
3. It should not form ash.
4. It should not form harmful products, *i.e.*, it should create minimum pollution.
5. It should be easily storable and transportable.
6. It should be easily regulated.
7. It should be readily combustible.

2.6. Coal. Coal is a highly complex mixture of carbon compounds and free carbon. Some nitrogen, sulphur compounds are also present in the coal. It is found in coal mines, situated deep under the surface of earth.

2.7. Carbonisation of Coal. When coal is heated to a temperature above 1000°C in the absence of air (or destructively distilled), volatile matter escapes out and a dense, strong mass, called "coke" is left behind. This process of preparing coke from coal is known as carbonisation of coal.

2.8. Products obtained by dry distillation of coal. Coal is heated at temperatures above 1000°C in absence of air in a vessel. The gases produced are passed through water. The process gives three main products :

(*i*) *Coke:* A dense, strong residue left in the heating vessel.

(*ii*) *Coal tar.*

(*iii*) *Ammoniacal liquor* (solution of ammonia)

(*iv*) *Coal gas*

2.9. Classification of fuels. Fuels, according to their state of occurrence, are classified as :

(*a*) Natural or primary fuels which are found in nature as such, *e.g.*, wood, peat, coal, petroleum, natural gas, etc.

(*b*) Artificial or secondary fuels are those which are prepared from the primary fuels. For example, charcoal, coke, kerosene oil, diesel oil, petrol, coal gas, oil gas, producer gas, blast furnace gas etc.

The second classification is based upon their state of aggregation like : (*a*) solid fuels, (*b*) liquid fuels, and (*c*) gaseous fuels. The classification of fuels is summarised below :

State of existence	*Natural (or primary)*	*Artificial (or secondary)*
1. SOLIDS	Wood, peat, lignite, coal, dungs.	Wood charcoal, coke, coal briquettes, etc.
2. LIQUID	Petroleum	Tar, kerosene oil, diesel oil, fuel oil, petrol etc.
3. GASEOUS	Natural gas	Coal gas, blast furnace gas, water gas, oil gas, coke oven gas, biogas, etc.

2.10. Fossil fuels. Coal, petroleum and natural gas are examples of fossil fuel. These are formed in nature due to the decomposition of animals and plants which have remained embedded inside earth's crust due to geological changes.

2.11. Biogas. It is produced by the degradation of biological matter by the bacterial action (of anacrobic bacterias) in the absence of free oxygen.

Examples :

(*i*) Natural gas is a biogas, which results after a long period decay of animal and vegetable matter buried inside the earth.

(*ii*) Gobar gas (or dung gas), which is produced by the anaerobic fermentation of cattle dung.

(*iii*) Biogas can also be produced from the sewage waste and other organic wastes.

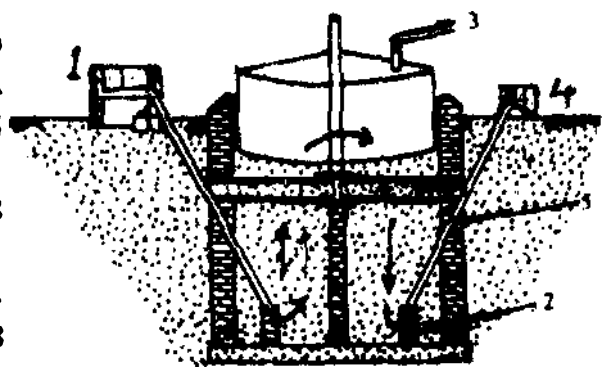
2.12. Production of biogas on large scale. The animal and agricultural wastes can be degraded (decomposed) to obtain biogas in specially designed plants. Such a plant is called as biogas plant (or gobar gas plant).

There are two types of biogas plants currently in use. These are :

(*i*) Fixed dome type biogas plants.

(*ii*) Floating gas holder type biogas plants.

These are shown in Figs respectively.



1. Inlet for water and dung mixture. 2. Main tank. 3. Outlet for gas. 4. Outlet for slurry. 5. Cement pipes.

Fig. Floating gas holder type biogas plant

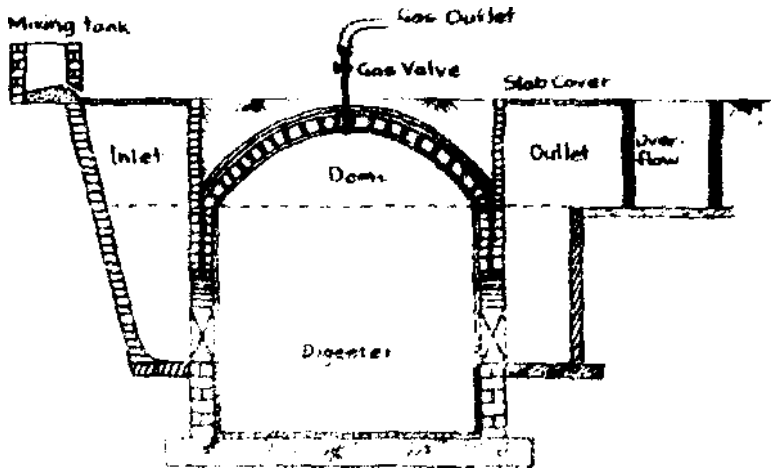


Fig. Fixed-dome type biogas plant

A slurry (thin paste) of animal dung and water is introduced into the plant through an inlet pipe. Sometimes, domestic agricultural waste and/or sewage can also be used as the feed material. This biomass undergoes slow bio-degradation in the presence of anaerobic micro-organism to produce biogas. The biogas so produced is drawn off through an outlet and supplied to the consumer through a pipe-line. In order to make it run almost continuously, the plant is fed with the feed regularly, while the spent biomass is removed through an outlet. The spent slurry is rich in nitrogenous and phosphorus compounds and as such can be used as manure.

2.13. Petroleum. It is a dark coloured liquid with a characteristic smell. It is lighter than water and isoluble in it. It consists of a mixture of hydrocarbons whose composition varies from place to place.

2.14. Occurrence of petroleum. It is found between certain sedimentary layers of the earth's crust. It is assumed that when micro-organisms living in sea die, they sink to the bottom and are gradually covered by sand and clay. It is assumed that under the conditions of intense pressure and probably high temperature and catalytic action over a period of millions of years, these remains are converted into liquid hydrocarbons. These lighter hydrocarbons rise through porous rocks until they are intercepted by some impermeable rocks, thus forming an oil trap.

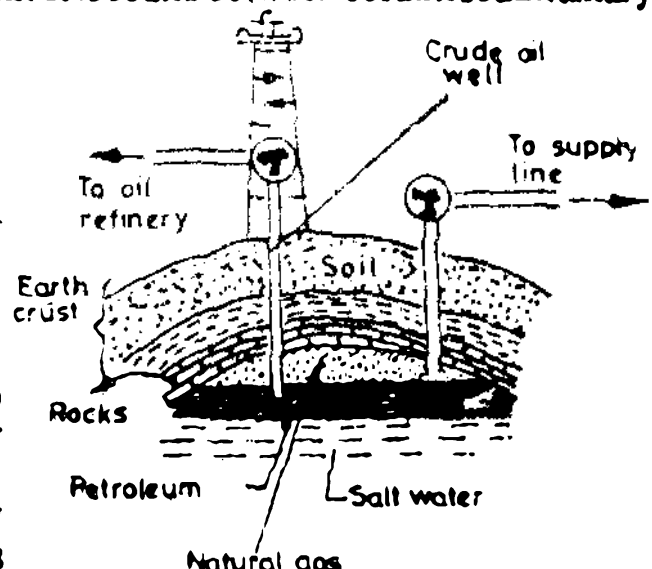


Fig. Occurence of Petroleum

2.15. Necessity of refining of petroleum. Petroleum obtained by drilling holes in the earth's crust is a crude oil and contains a mixture of substances besides water and earthy particles. It cannot be put to use as such. It is, therefore, separated into constituents which are used for specific purposes. The process of separation is called refining of petroleum and is done by a technique known as fractional distillation.

2.16. Fractional distillation of crude oil. Petroleum (crude oil) which is a complex mixture of hydrocarbons, is converted into a variety of usable products by fractional distillation. This is called the refining of crude oil. Each product obtained is a simpler mixutre of compounds, which boils within a narrow range of temperature. Such refining is done by introducing the vapours of the crude oil into a fractionating column through an inlet near its bottom. High boiling fraction condenses while the vapours move up. Due to a regular temperature gradient along the height of the column, fractions with different boiling points get liquified at different heights, and can be tapped out (Fig.) Major products obtained from the fractional distillation of crude oil are :

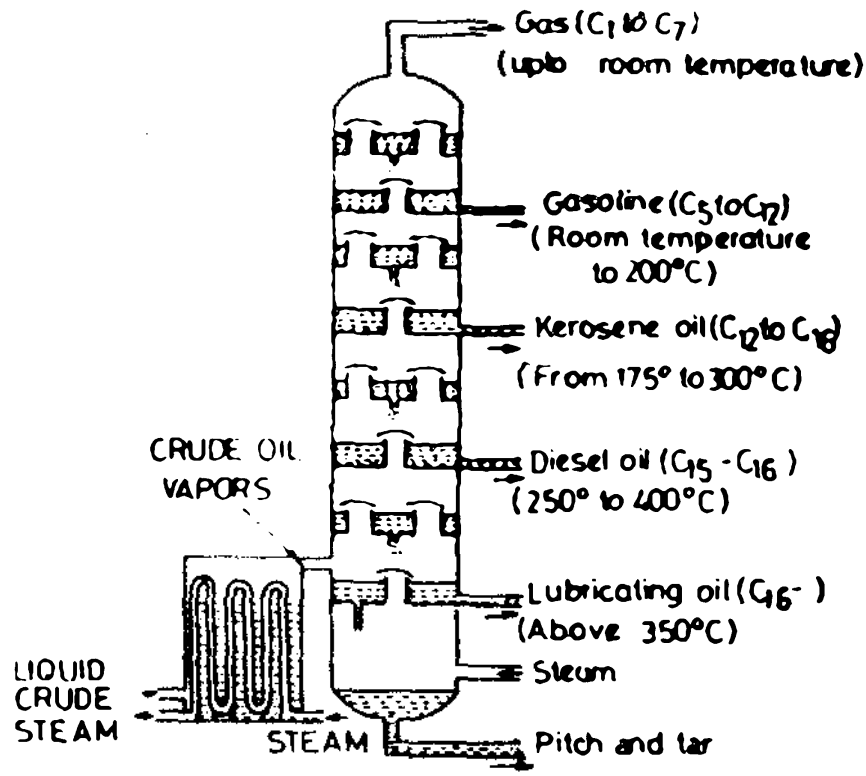


Fig. Fractional Distillation of Crude Oil

S.No	Product	Chain length	Boiling range	Uses
(*i*)	Gas	C_1 to C_4	Below room temperature	As fuel ; for the manufacture of gasoline and rubber
(*ii*)	Petroleum ether	C_5 to C_7	18° – 70°C	As a solvent, and in dry-cleaning.
(*iii*)	Petrol or gasoline	C_5 to C_{12}	70° – 150°C	Motor fuel ; dry-cleaning.
(*iv*)	Kerosene oil	C_{12} to C_{16}	150° – 315°C	As fuel and illuminant.
(*v*)	Gas oil or heavy oil	C_{15} to C_{18}	upto 375°C	Furnace oil ; fuel.
(*vi*)	Residue	C_{18} – up	Above 400°C	On further fractionation gives, paraffin wax, vaseline, lubricating oil, pitch, and petroleum coke.

2.17. Liquid petroleum gas (LPG). The gas leaving from the top of the fractionating column of an oil refinery contains hydrocarbons, ethane, propane and butane. Butane is the chief constituent. This gas mixture gets condensed under pressure. This condensate is known as liquid petroleum gas (LPG), and is supplied in cylinders under high pressure. On releasing the valve, LPG vaporises to give a gas. This gas can be used as a fuel in a gas burner. The calorific value of this gas is very high (50 kJ per gram).

2.18. Natural gas. The crude oil occurs deep below the earth's crust and often floats on salt water. The oil is covered by an atmosphere of the more volatile (low boiling) hydrocarbons. This gaseous mixture is known as natural gas. This contains mainly lower hydrocarbons. It can be directly used as a fuel. The natural gas is a very cheap raw material for petrochemicals, and fertilizers. It also finds good use for electricity generation, our country has recently discovered many natural gas deposits. These are in, Tripura, Jaisalmer, offshore area of Bombay and in the Krishna Godavari delta.

2.19. Petrochemicals. Petrochemicals are the substances which can be obtained using various fractions of petroleum as raw material. For example, the natural gas and benzene are the most valuable raw materials.

2.20. Cracking. It is the decomposition of higher hydrocarbon molecules into lower hydrocarbons of lower molecular mass.

$$\underset{\text{higher hydrocarbons}}{C_{10}H_{22}} \xrightarrow{\text{heat}} \underset{\text{lower hydrocarbons}}{C_8H_{18} + C_2H_4}$$

2.21. Fuels in rockets. These are called propellants because they supply nough energy for propulsion of rockets in space.

2.22. Characteristics of good propellant.

(*i*) It should produce a large volume of gases for each gram of fuel burnt.

(*ii*) Combustion must take place at high rates.

(*iii*) No residue should be left behind after the fuel is burnt.

2.23. Commonly used propellants.

(*i*) **Solid propellants.** These consist of a mixture of hydrocarbon and an oxidiser like chlorate, perchlorate or a nitrate. For example, a mixture of aluminium powder, polybutadiene acrylic acid, aluminium perchlorate and a suitable additive (which binds the fuel and the oxidant).

(*ii*) **Liquid propellants.** These are mixtures of fuels like alcohol, liquid hydrogen, hydrazine etc. mixed with oxidising agents such as liquid oxygen and hydrogen peroxide. For example, a mixture of methyl hydrazine and the oxidiser dinitrogen tetraoxide was used in Apollo rocket which flew man to the moon.

2.24. Calorific value of fuel. It is defined as the amount of heat produced in Joules when one gram of it is completely burnt.

2.25. Calorific value of hydrogen. 150 kJ/g

2.26. Calorific value of methane. 55 kJ/g

2.27. Ignition/kindling temperature. Ignition temperature is the lowest temperature under normal pressure, upto which the combustible substance must be heated in order to start combustion. This is also known as kindling temperature. The substances which catch fire easily have low kindling temperature. For example, yellow phosphorus has a kindling temperature of 35°C. Substances having high kindling temperature need initial heating.

2.28. Difference between oxidation and combustion. Oxidation is a prerequisite for combustion. That is all combustion processes are also oxidation. For example, burning of carbon in O_2 or that of magnesium in nitrogen with the liberation of heat and light can be termed both oxidation as well as combustion.

On the contrary all oxidation reactions are not combustion. For example, dissolution of zinc in dilute hydrochloric acid is oxidation. But as no heat and light are evolved, this cannot be termed as combustion.

TEXT-BOOK QUESTIONS

Q. 1. Answer the following questions briefly :

(*a*) What are the advantages of smokeless chulhas ?

(*b*) How does a smokeless chulha differ from a traditional one ?

(*c*) How is charcoal obtained ?

(*d*) What are the constituents of biogas ?

(*e*) How was coal formed ?

(*f*) What are the common varieties of coal ?

(*g*) What are the uses of coal gas ?

(*h*) How was petroleum formed ?

(*i*) Where is natural gas usually found ? Why is it called a clean fuel ?

(*j*) Define the term 'calorific value of fuel'.

Ans. (a) 1. Its efficiency is more than traditional chulhas.

2. It does not lead to pollution which lead to health problems.

3. They allow better and complete combustion.

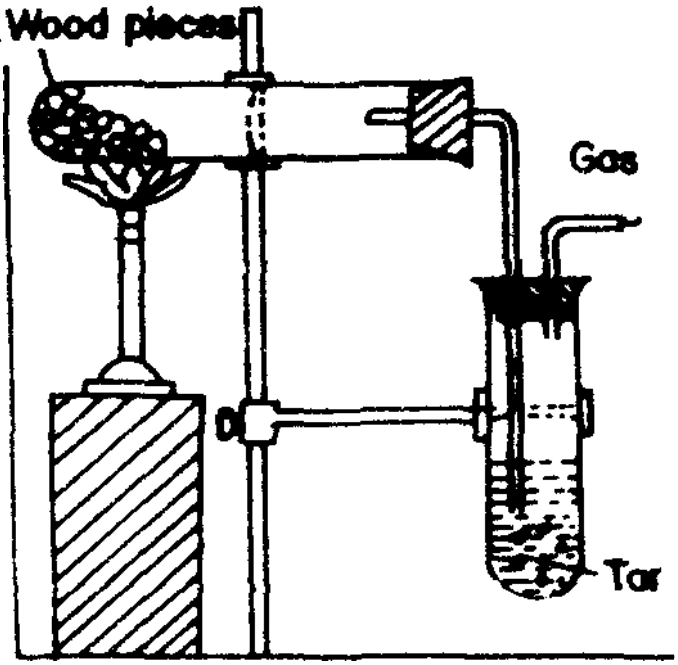
4. They need less fuel.

(b)	Traditional Chulhas	Smokeless Chulas
1.	It has poor efficiency of 8% only.	1. *It has good efficiency.*
2.	The combustion does not take place completely.	2. The combustion of fuel takes place completely.
3.	*It forms smoke* which contains harmful gases like carbon monoxide (CO), Hydrogen sulphide (H_2S) and Sulphur dioxide which leads to health problem.	3. It is attached with chimney which removes the smoke directly and does not create health problem.
4.	*It needs more fuel.*	4. It needs less fuel.

(c) Charcoal is a fuel. It is obtained by burning wood in an insufficient supply of air when volatile matter in wood is driven off leaving behind a residue which is called charcoal. Charcoal is mainly carbon.

Take some small pieces of soft wood in a hard glass boiling tube. Pour some water, about two cm deep in another boiling tube. Assemble the equipments as shown in fig.

Heat the pieces of wood, first on a low flame and then more intensely. You will notice drops of tar collecting in the vertical tube and a gaseous mixture coming out through the open tube. If you bring a lighted matchstick near the gas it catches fire. Stop the heating. Cool the boiling tube and observe the residue in the horizontal test tube. This black residue is charcoal. It is found that, one kg of wood on an average yields about 0.25 kg of charcoal.



(d) Biogas contains 55% methane and other gases like carbon dioxide (35%), hydrogen (5%), hydrogen sulphide (traces) nitrogen (6%).

(e) About 250 million years ago, many forests got buried in the earth. These forests were converted into coal due to the action of heat and high pressure inside the earth. This process is known as carbonisation. Coal, thus obtained, contains moisture, sulphur and other impurities.

(f) The common varieties of coal are

1. Lignite 2. Anthracite 3 Bituminous

1. **Lignite.** It is the brown variety of coal. It contains 30% carbon, 25% volatile matter and 40% moisture.

2. ***Anthracite.*** *It is also called hard coal. It contains 92% carbon, 5%* volatile matter and 3% moisture.

3. **Bituminous.** It is also called soft coal. It contains about 80% carbon. It is used for domestic purpose.

(g) 1. It is an excellent fuel.

2. It can be used for lighting homes, factories and streets.

3. It can be used for domestic cooking.

(h) Petroleum was formed by the bacterial decomposition of plant and animals remains under high temperature and pressure inside the earth's crust in absence of air. These changes were accompanied with evolution of gases which are formed by the conversion of nitrogen, sulphur and oxygen present in marine organisms into inorganic compounds. Most of the carbon is transformed into natural gas and petroleum.

(*i*) It occurs along with petroleum. Many oil wells produce natural gas as by-product. There are some wells which produce only natural gas. It occurs deep inside the earth generally over petroleum.

It is called clean fuel because it does not form smoke, does not leave residue and does not form harmful products.

Q. 2 Fill in the blanks :

(*a*) Of the three varieties of coal ---------- has the highest carbon content.

(*b*) When methane burns ---------- and ---------- are produced.

(*c*) Burning of wood and coal causes ---------- of air.

(*d*) ---------- is the best fuel in terms of energy released per gram of fuel.

(*e*) Fuel must be heated to ---------- temperature before it can catch fire.

(*f*) Our body obtains energy by burning ---------- in cells.

(*g*) The candle flame has ---------- zones namely ----------.

(*h*) ---------- micro-organisms degrade animal and plant wastes in biogas plants.

(*i*) The destructive distillation of coal produces ---------- and ----------.

(*j*) Petroleum gas is a mixture of ----------, ---------- and ----------.

Ans. (a) Of the three varieties of coals, anthracite has the highest carbon content.

(*b*) When methane burns carbon dioxide and water are produced.

(*c*) Burning of wood and coal causes pollution of air.

(*d*) Hydrogen is the best fuel in terms of energy released per gram of fuel.

(*e*) Fuel must be heated to ignition temperature before it can catch fire.

(*f*) Our body obtains energy by burning food material in cells.

(*g*) The candle flame has four zones, namely the zone of no combustion, the zone of partial combustion, the zone of complete combustion and the blue zone at the base.

(*h*) Anaerobic micro-organisms degrade animal and plant wastes in biogas plants.

(*i*) The destructive distillation of coal produces coke, coal tar and coal gas.

(*j*) Petroleum gas is a mixture of butane and isobutane.

Q. 3 Give reasons why

(*a*) Charcoal is a better fuel than wood.

(*b*) Natural gas is a good fuel.

(*c*) Respiration is called slow combustion.

(*d*) In a wick stove kerosene burns with a blue flame but produces a yellow flame when burned in a lamp.

(*e*) Biogas plants are considered to be a boon to farmers.

(*f*) The calorific value of methane is higher than that of butane.

(*g*) Air pollutants produced by the burning of oil products are more difficult to control than those produced by burning of coal.

Ans. (a) Charcoal has higher carbon content as compared to that of wood. The moisture and volatile matter content of charcoal is less than that of wood. This results in a higher calorific value of charcoal.

Charcoal : 33 kJ g^{-1}

Wood : 17 kJ g^{-1}

(*b*) Natural gas contains lower hydrocarbons. The main constituent being methane. Methane burns without smoke and has high calorific value (55 kJ/g). Being gaseous, it can be transported through a pipeline. Thus, it can be directly used by the consumer. It does not leave any ash after burning. Thus, natural gas has all the properties of a good fuel.

(*c*) Respiration is the reaction in which the food is burnt at body temperature (note: there is no flame during food burning) in the presence of oxygen (supplied by the inward breathing) producing CO_2 and energy. The reaction may be written as,

food + Oxygen → water + Carbon dioxide + energy

The burning of food and hence the release of energy is rather slow. Hence, respiration is called slow combustion.

(*d*) The kerosene produces a yellow flame in the lamp because of incomplete combustion. The unburnt carbon particles glow while hot and make the flame luminous (yellow).

In the wick stove the flame is surrounded by a perforated jacket. This allows a regular supply of air and as a result complete combustion of kerosene. That is why the flame in wick type stove is blue (or non-luminous).

(*e*) The biogas plants are helpful to the farmers because :

(*i*) Biogas plants use the animal and agricultural waste as the feed material. Thus, solving the problem of disposal of these wastes.

(*ii*) The biogas can be used as a fuel and an illuminant. Since, the burning of biogas does not produce smoke and leave no ash. Hence the environment is not polluted by the use of biogas.

(iii) The 'spent feed' (the slurry) left in the plant, after the gas has been used, is rich in nitrogenous and phosphorous compounds. This can be used as a good manure by the farmers.

(f) The calorific value of methane is higher than that of butane.

The amount of heat released on burning a unit mass (say 1 g) of methane is higher than that released by burning 1 g of butane.

(g) Air pollutant produced by burning of oil products are more difficult to control than those produced by the burning of coal.

Burning of oil produces a variety of air pollutants like carbon particles, CO, CO_2 oxides of nitrogen, some alcohols and acids. On the other hand, when coal is burnt in sufficient supply of air, the main pollutant is CO_2 which is not much harmful and further plants use CO_2 to produce their food. Therefore, air pollutants produced by the burning of oil products are more difficult to control than those produced by burning of coal.

Q. 4 Write explanatory notes on :

(a) Liquified petroleum gas.

(b) Destructive distillation of coal.

(c) Fractional distillation of crude oil.

(d) Pollution due to burning of fossil fuels.

(e) Characteristics of an ideal fuel.

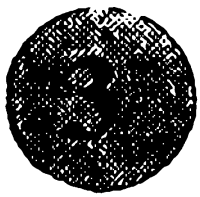
Ans. (a) See art 2.17.

(b) when coal is heated in closed retorts in the absence of air, a number of volatile components present in the coal are expelled and residue left in coke. The process of strong heating of coal in closed retorts in the absence of air is called destructive (or dry) distillation of coal. Also see art 2.8.

(c) See art 2.16.

(d) Coal, petroleum and natural gas are examples of fossil fuels. Combustion of fossil fuels in sufficient amount of oxygen produce CO_2 gas and a lot of smoke is released into the atmosphere. Increased proportion of CO_2 in the atmosphere leads undesirable change in climate. If the O_2 supply is insufficient, fossil fuel burns to produce poisonous gas carbon monoxide, unburnt carbon, sulphur dioxide, hydrocarbons (CH_4) acid, alcohols, NO_2 etc and these enter the atmosphere and pollute atmosphere. Hydrocarbons produce a number of petrochemical oxidants and smog, which possesses physiological damaging effects on human being. Carbon monoxide reacts with haemoglobin (blood) forming carboxy-haemoglobin. Petrol usually contains additives like lead salt which produces poisonous lead compound air.

(e) See art 2.5.



THE SUN AND NUCLEAR ENERGY

3.1. Sun energy is useful to us. The sun energy is useful to us because :

(*i*) It regulates the flow of wind and water cycles on the earth.

(*ii*) It helps the plants to grow which in turn provides food to us.

(*iii*) It can be used for heating and cooking purposes.

3.2. Source of Sun's energy. The sun provides energy. The natural question is how this energy is produced in the sun. In 1920, scientists established that the sun was largely made up of hydrogen. In 1939, a German physicist, H. Bethe proposed that the sun contains in its core (the central part) hydrogen nuclei moving at very high speeds. When these fast moving hydrogen nuclei collide, they fuse to form a nucleus of a heavier element. In the process a large amount of energy is released. It is this energy which powers the sun.

3.3. Detection for the presence of hydrogen. In 1920, scientists found that all substances when red-hot emit radiation of characteristic wavelengths. By studying the spectrum of sunlight, it was observed that it resembled with that of hydrogen. Thus, it was concluded that the sun was mainly made up of hydrogen.

3.4. We feel hot in the Sunlight. Infra-red light can heat-up an object placed in its path. We feel hot in the sun-light because one-third of the light from the sun is infra-red.

3.5. Range of wavelength of the visible light. Approximately from 0.4 microns to 0.7 microns.

3.6. Ultraviolet light. The light whose wavelength is shorter than that of the violet light is known as the ultraviolet light.

3.7. Infrared light. The light whose wavelength is longer than that of red light is known as infra red light.

3.8. Renewable source of energy. Renewable source of energy is produced continuously in nature and is not exhaustible. This is not conventional source of energy.

Examples : Plant, Wood, Falling water, Geothermal power, Vegetable refuge, etc.

3.9. Non-renewable source of energy. Non-renewable source of energy gets exhausted over the ages and is not easily replaceable. This is a conventional source of energy.

Examples : Coal, Natural gas, Crude petroleum oil, Uranium, etc.

3.10. Nuclear change. It is one in which the nucleus of an atom of an element is converted into the nucleus of an atom of another element. Thus, nuclear change can be regarded as a change of one substance into another.

3.11. Difference between chemical reaction and nuclear reaction

Chemical reaction	*Nuclear reaction*
1. Involves changes only in the electronic configurations, particularly of valence electrons, of the atoms involved. Nucleus is not involved.	1. Involves changes both in electronic configuration and nucleus.
2. Atomic numbers of elements involved do not change.	2. Atomic number changes.
3. There is no loss in total mass as a result of reaction.	3. Loss of mass occurs and this is converted into energy.
4. Though new compounds may be formed but basic elements remain same. Atoms are only rearranged in a different way.	4. Altogether new entities are formed which were in no way present in the original reactants.
5. Rate of reaction is influenced by temperature and pressure.	5. Rate of nuclear reaction remains unaltered since temperature and pressure have no effect on them.

3.12. Isotopes. Different atoms of the same element having the same atomic number but different mass number are called isotopes.

3.13. Properties of isotopes

(*i*) Isotopes of an element have similar chemical properties. But physical characteristics differ slightly.

(*ii*) Isotopes of an element have similar electronic configuration.

(*iii*) They have the same number of valence electrons.

Examples : Some of the typical examples are given below :

Name	*Formula*	*Mass Number (A)*	*Number of Protons (P)*	*Number of Neutrons (N)*
Protium	${}_{1}^{1}H$ (H)	1	1	0
Deuterium	${}_{1}^{2}H$ (D)	2	1	1
Tritium	${}_{1}^{3}H$ (T)	3	1	2

Uranium (symbol; U) has 2 prominent isotopes *viz.* Uranium-235 and Uranium-238. These were written as

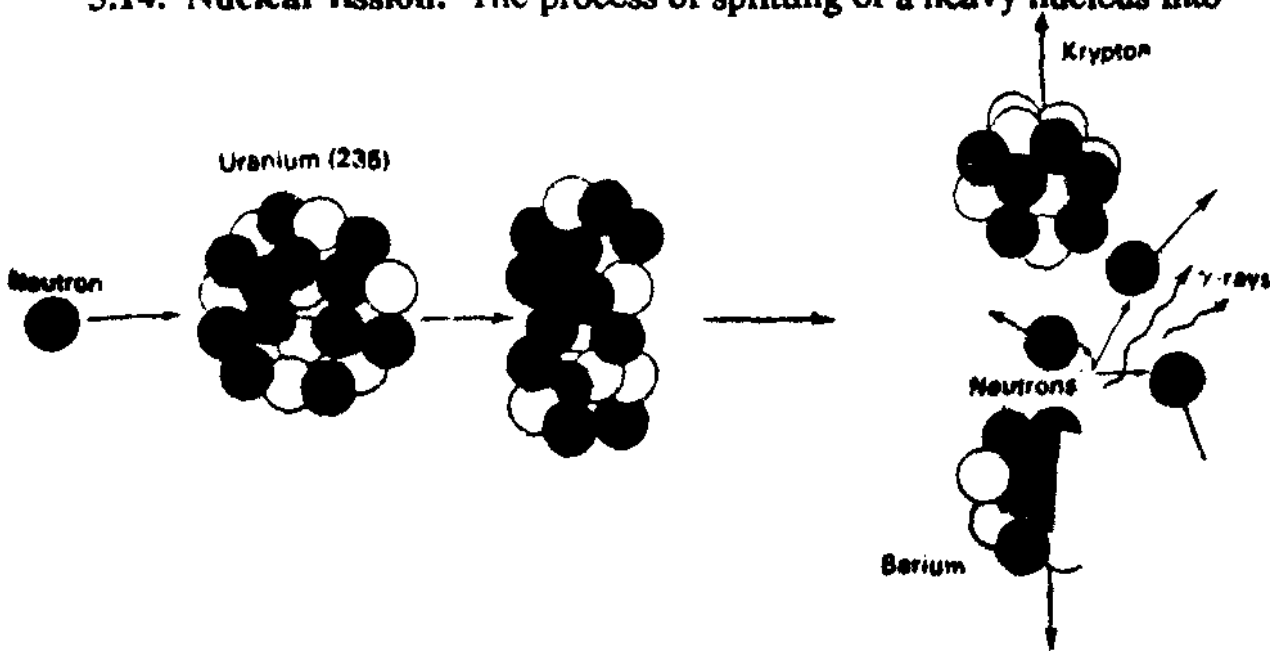
${}_{92}^{235}U$ ${}_{92}^{238}U$

(92 is the atomic number and 235 and 238 are the mass numbers of the two nuclei.

The composition of the two nuclei is:

Isotope	*No. of*	
	Protons	*Neutrons*
${}_{92}^{235}U$	92	143
${}_{92}^{238}U$	92	146

3.14. Nuclear fission. The process of splitting of a heavy nucleus into



two lighter nuclei of nearly comparable masses with simultaneous liberation of a huge amount of energy, is called nuclear fission.

The disintegration of Uranium (235) nucleus can easily be achieved by bombarding it with a slow moving neutron. As shown in Fig. the Barium (Ba) and Krypton (Kr) and is accompanied with the released three new neutrons. In this process there is a decrease in nuclear mass and enormous amount of energy is released due to conversion of mass into energy.

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{144}_{56}Ba + ^{90}_{36}Kr + 3\,^{1}_{0}n + \text{Energy}$$

3.15. Nuclear reaction. A reaction in which the particle which initiates (or starts) a reaction is also produced in larger number during the course of reaction, is called a chain reaction. In other words, a chain reaction once started, goes on till one of the reactants is consumed completely.

Example : The fission of uranium-235 by slow neutrons is a self-propagating chain reaction, because once this reaction is started by neutrons, more and more neutrons are produced which starts reaction in other U-235 atoms. Thus :

$$^{235}_{92}U + ^{1}_{0}n \xrightarrow{\text{Fission}} ^{144}_{56}Ba + ^{90}_{36}Kr + 3\,^{1}_{0}n + \text{Energy}$$

(1 neutron) (3 neutrons released)

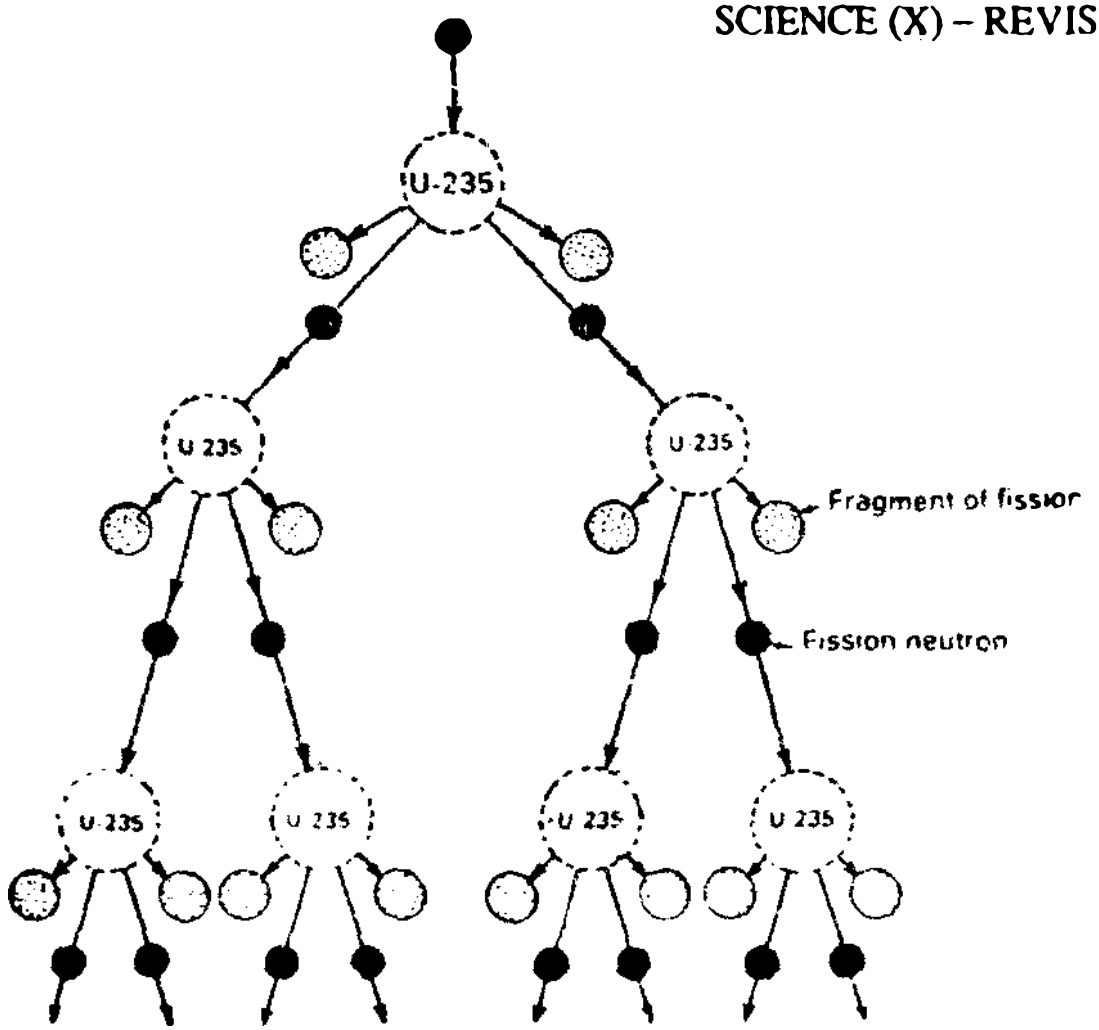


Fig. Chain reaction

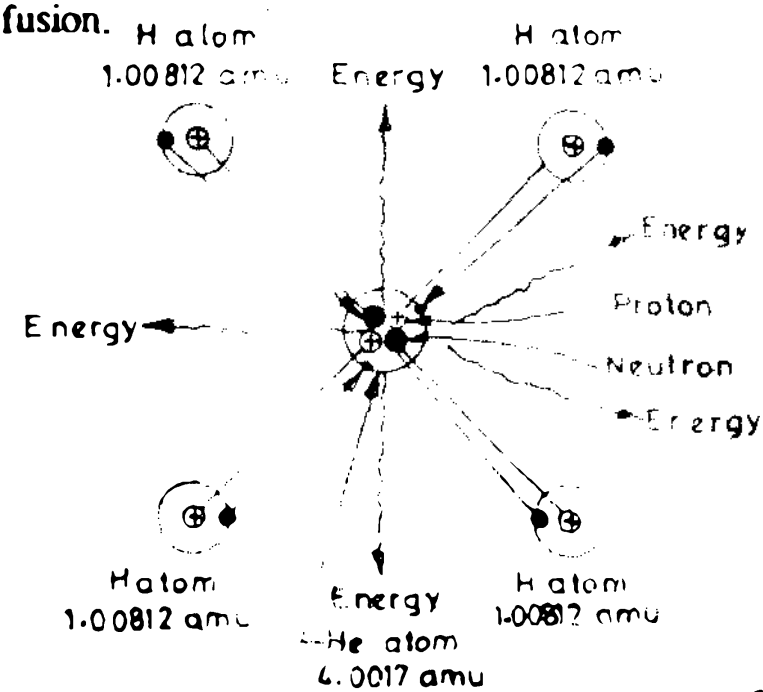
3.16. Nuclear fission reaction is a chain reaction. Fission reaction is a self-propagating chain reaction, because fission products contain neutrons (called, secondary neutrons), which can further cause fission in other nuclei producing more secondary neutrons. Thus, the process of neutron production is multiplied (see Fig.) and hence the fission process is a self-propagating chain-reaction.

3.17. Controlled and Uncontrolled nuclear fission. For every neutron used in a fission reaction, more than two neutrons are ejected. The number of neutron resulting from a single fission is known as the multiplication factor. When this is less than 1, a chain reaction is impossible, but when it is greater than 1, a chain reaction might take place.

(i) *In controlled nuclear fission reactions* in a nuclear reactor, the fissionable material is so arranged that the multiplication factor can be carefully controlled to 1. The reaction is non-explosive in nature.

(ii) *In uncontrolled nuclear fission reactions,* the multiplication factor is allowed to exceed 1. So, the reaction is explosive in nature. For example, in atomic bomb.

3.18. Nuclear fusion. The process of combining (or fusion) of light-weight nuclei to form heavier nuclei with the simultaneous release of energy, is called nuclear fusion.



Example : Four nuclei of hydrogen at extremely high temperature (10^7°C) in sun fuse into a single nucleus of helium with simultaneous release of huge amount of energy :

$$4\,{}^{1}_{1}H \rightarrow {}^{4}_{2}He + 2\,{}^{0}_{+1}e + \gamma\text{-rays}$$
(positron)

When 1 mole of helium is formed, 2.81×10^2 kJ of energy is liberated (see Fig.).

3.19. Soruce of energy in a nuclear fusion. The source of energy released in a nuclear fusion reaction is convertion of mass into its equivalent amount of energy.

3.20. Difference between nuclear fission reaction and nuclear fusion reaction.

Nuclear fission reaction	*Nuclear fusion reaction*
1. Decompostion of heavy nucleus into fragments.	1. Fusion of two light nucleus to form a heavy nucleus.
2. Needs ordinary initiation temperature.	2. Initiation temperatures are very high

3. Comparatively lower amount of energy is obtained.	3. Quantity of energy liberated is very high.
4. Products of fission reactions are generally radioactive.	4. Products of fusion reactions are not radioactive.
5. Controlled fission reactions are safely carried out to generate power.	5. Controlled fusion reactions are not yet obtained.

3.21. **Nuclear Reactor** A nuclear reactor is an apparatus in which the *nuclear fission is carried out in a controlled and self-sustaining manner.*

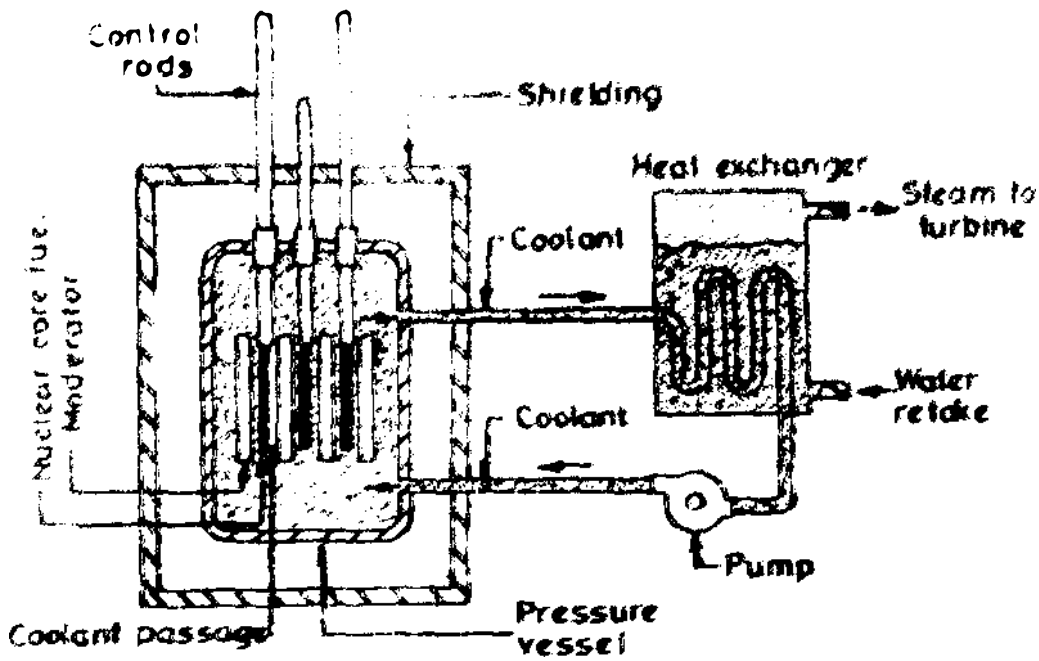
3.22. **Essential components of nuclear reactor.**

(i) The Core. It consists of aluminium coated uranium rods (1.5" × 4") arranged in a circular cross-section. Nuclear fission takes place in this part.

(ii) Moderator. The core is surrounded by a substance called moderator. Moderators slow down the speed of the released neutrons. Typical moderators are heavy water (D_2O), graphite.

(iii) Control rods. The rods made of cadmium or boron steel can be positioned to regulate the neutron flux in the reactor. Moving the control rods into or out of the pile reduces or increases the neutron flux.

(iv) Coolant. The heat produced in the reactor is removed by a liquid called the coolant. Liquid sodium is generally used as a coolant. The coolant takes the heat to the heat exchanger for raising steam.

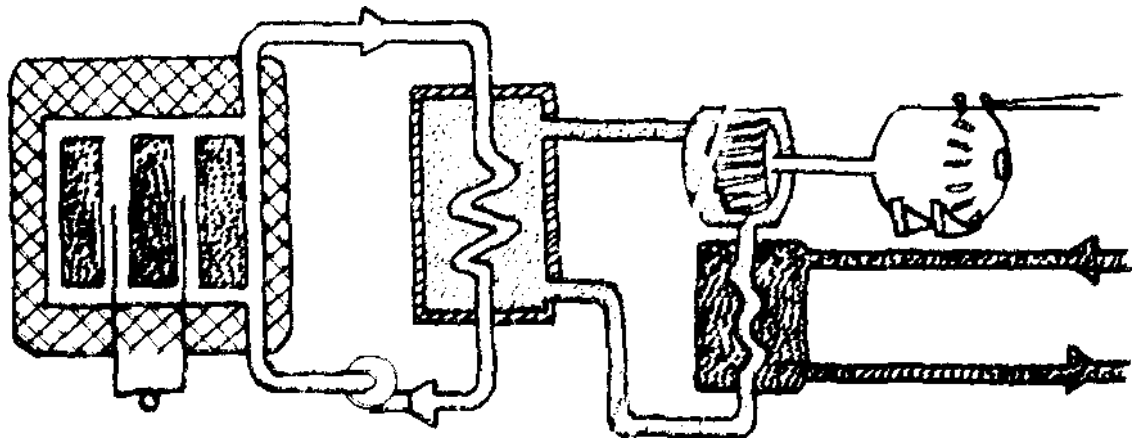


(v) *Shield or Protective screen.* A protective screen made of special concrete about 8 feet thick is built around the reactor. It stops heat, γ-rays and neutrons from escaping from the reactor.

An outline of a nuclear reactor is shown in Fig.

3.23. Electricity is generated from nuclear reactor. The heat produced in the nuclear reactor is carried by the coolant to the heat exchanger. The steam generated in the heat exchanger is made to run the Turbines to generate electricity.

A schematic diagram showing the nuclear power plant is shown below.



TEXT-BOOK QUESTIONS

Q. 1 Describe the form in which we receive the sun's energy.

Ans. *The sun emits light of different wavelengths ranging from ultraviolet and the visible to the light of the hot infra-red. Visible light contains wavelengths of colours from violet to blue, yellow and finally red. Infra-red light has an important property in that it can heat an object placed in its path. One third of the light from the sun is infra-red. The heat that we feel in sunlight is due to the infrared radiations from the sun.* Thus we receive 1.36 kJ of energy per second per square metre of earth's upper atmosphere. Out of this only 47% reaches the earth's surface, since remaining 53% is either reflected back or is absorbed by water vapour, ozone, dust and carbon dioxide present in the atmosphere.

Q. 2 The earth receives 1,000 watts of energy per sq.m. from the sun. If all the energy were to be absorbed by a bucket of water (30 litres) in half an hour. What should be the rise in temperature ?

Ans. Mass of water $= 30$ kg

Specific heat of water $= 4{,}190\ \text{J kg}^{-1}$

Rise in temperature $= t°\text{C}$

Heat absorbed by water $= mst$

$= 30 \times 4{,}190 \times t$ joules

Heat given out by sun $= 1{,}000$ watts

$= 1{,}000\ \text{Js}^{-1}$

Total time $= 30 \times 60$ s

∴ Total heat given out by sun in 30 minutes

$= 1{,}000\ \text{Js}^{-1} \times 30 \times 60$ s

Now Heat gained = Heat lost

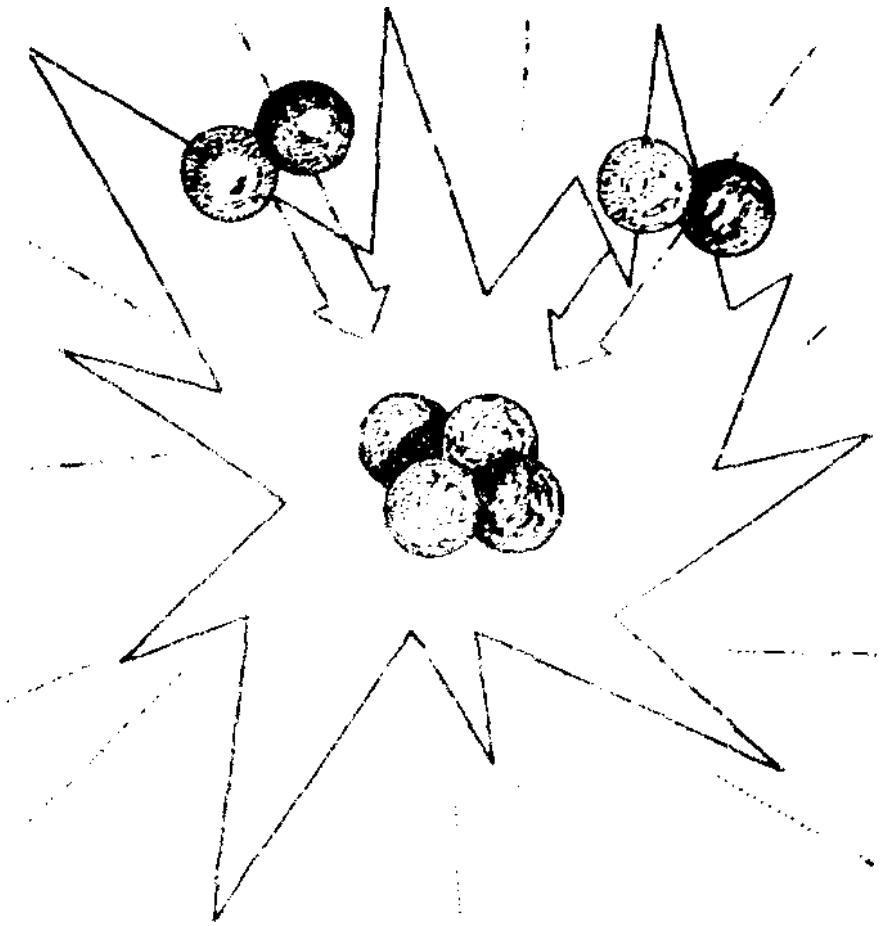
$30 \times 4{,}190 \times t = 1{,}000 \times 30 \times 60$

or $$t = \frac{1{,}000 \times 30 \times 60}{30 \times 4{,}190}$$

$= 14.32°\text{C}$

Q. 3 Describe the process by which energy is released by the sun.

Ans. Nuclei of deuterium (i.e. the heavier isotope of hydrogen collide in the sun's interior to produce helium. See fig. A lot of energy is released in this reaction, which fires the sun which in turn emits lights of different wavelengths. The reaction in which hydrogen in the sun is converted into helium accompanied with the release of energy, is called a fusion reaction. The word 'fusion' is derived from 'fuse' which means to join together. For fusion of hydrogen to occur, the nuclei have to collide at very high speeds. Such speeds are only possible when the temperature is very high about 4×10^6°C. One gram of hydrogen in the sun releases 62×10^9 joules of energy. (When one gram of coal is burnt in air - only about 350 joules of energy is released). When all the hydrogen in the sun has been so converted to helium, the reactions would, of course, stop. As a result of this the temperature and pressure inside the sun would decrease and the sun would begin to collapse under its own gravitational attraction. As it shrinks, the temperature in the interior of the sun would rise again, till it is, so high that helium nuclei begin to form the nucleus of carbon.



Q. 4 It is said that energy from nuclear fusion would create fewer pollution problems than energy from fission. Can you reason why ?

Ans. The products and by products of fission reactions are radioactive and very harmful to mankind, since radiations emitted during fission can penetrate our bodies and damage the tissue cells. Moreover, disposal of radioactive wastes obtained from nuclear fission reaction is a problem, since no suitable method is available for their disposal. On the other hand, the products of a fusion reaction are usually non-radioactive and harmless; and therefore the problem of their disposal does not arise. Hence, the energy from nuclear fusion would create fewer pollution problems than energy from fission.

Q. 5 State two disadvantages of energy systems using nuclear fission over those using fossil fuels. Also state two advantages.

Ans. Disadvantages. 1. Mostly uranium is used in the nuclear fission reactions. The quantity of this uranium is very limited on the earth. On the other hand, fossil fuels are present everywhere on the earth.

2. For the nuclear fissions to take place, the nuclear reactions are required which are very expensive. It means that getting energy from the nuclear

fissions is very much expensive. However, the energy from the fossil fuels can be easily released without much efforts. Therefore, it is much difficult to get energy from the nuclear fission than from using fossil fuels

Advantages. 1. The amount of energy released during nuclear fission is very much larger than that released from the fossil fuels.

2. The energy released during nuclear fission can be utilised for many useful purposes such as producing electricity, operating large furnaces, etc. The fossil fuels on the other hand, can't be used for these purposes.

NUTRITION

4.1. Food. It is a mixture of certain chemicals that removes hunger and gives a feeling of strength to work, to build tissue and to store energy.

4.2. Different components of food. The food has six components :

1. Carbohydrates, 2. Protein, 3. Fats, 4. Water,
5. Minerals, 6. Vitamins.

4.3. Carbohydrates. Carbohydrates are such organic compounds which are composed of carbon, hydrogen and oxygen. The ratio of hydrogen and oxygen is the same as in water.

4.4. Sources of Carbohydrates. The carbohydrates are obtained from wheat, rice, potato, banana, sugar, gur, Tapoica, Honey and Jaggery.

4.5. Carbohydrates are stored in the body. Excess of carbohydrates are stored in the liver and in the muscles as glycogen.

4.6. Energy stored in the body. The energy is stored in the body in the form of adenosine triphosphate (A.T.P.).

4.7. Fats. The fats are those organic compounds which are composed of carbon, hydrogen and oxygen but hydrogen and oxygen are not in the ratio of 2 : 1.

4.8. Sources of fats. The various sources of fats are in the form of ground nuts, cashew nut, butter, ghee, meat, egg and milk.

4.9. Proteins. Proteins are organic compounds of higher molecular weight formed of amino acids.

4.10. Sources of proteins. Egg, meat, fish, pulses specially soyabean and milk.

4.11. Protein calorie malnutrition. It signifies the deficiency of protein in the food of children below the age of five years. It causes two main diseases, the marasmus and Kwashiorkor.

4.12. Malnutrition. The diet which does not meet the requirements of an individual is called malnutrition

4.13. Balanced diet. Proportions of proteins, fats, carbohydrates, salts, water and vitamins needed to meet the nutritional requirement of the organism.

4.14. Dehydration. the excess loss of water from the tissues of the body.

4.15. Fat soluble in vitamins. Vitamins A, D, E and K.

4.16. Water soluble vitamins. Vitamins C and B-Complex.

4.17. Vitamin which is associated with clotting of blood. Vitamin K.

4.18. Vitamin which is destroyed by air and heat. Vitamin C.

4.19. Glycogenesis. It is the conversion of glucose into glycogen in the liver.

4.20. Glyconeogenesis. It is the conversion of excess amino acids into carbohydrates in the liver.

4.21. Categories of Carbohydrates

1. Monosaccharides - glucose, fructose, galactose.
2. Disaccharides - maltose, lactose, sucrose.
3. Polysaccharides - starch and glycogen.

4.22. Monosaccharides. The simple carbohydrates having only one molecules of glucose. Its chemical formula is $C_6 H_{12} O_6$.

4.23. Disaccharides. A complex molecule of carbohydrate formed by the condensation of two molecules of simple sugars such as :

Maltose - glucose + glucose

Lactose - glucose + galactose

Sucrose - glucose + fructose

4.24. Polysaccharides. These are the complex compounds formed by the combination of a number of sugar molecules. These are in the form of starch and glycogen.

4.25. Basal metabolic rate. The minimum amount of energy required by the body for beating of the heart, circulation of blood, breathing and the regulation of body temperature is termed as basal metabolic rate or BMR.

4.26. Factors that affect the BMR

(i) Body size and composition
(ii) Age and growth
(iii State of nutrition
(iv) Climate

4.27. Amino acids. Amino acids are amphoteric compounds having one carboxyl and one aminogroup. These compounds contain nitrogen in addition to carbon, hydrogen and oxygen with sulphur or phosphorus.

Two amino acids are joined together by a peptide bond to form a dipeptide. When three it is tripeptide and when a number of amino acids are joined together, it is polypeptide.

4.28. Different types of amino acids. The amino acids are of two types :

(i) Essential amino acids

(ii) Non-essential amino acids

The amino acids which are not synthesised by the body, though vital for the maintenance of the body are essential amino acids. These are present in milk, meat, egg and soyabean.

The amino which are synthesised in the human body are called non-essential amino acids.

4.29. Characteristics of protein

1. It has a definite sequence of amino acids.
2. It has certain fixed number of amino acids.
3. The chain of protein is spirally coiled.

4.30. Different functions of fats. These are important food storage compounds. The fat is stored in adipose tissues. Phospholipids form cell membrane and enzyme system in mitochondria. The oxidation of fats yields large amount of energy to body cell. The fats protect the body from the effects of cold. The animal fats are the sources of vitamin A and D as the latter two are soluble in fats.

4.31. Effects of abnormal intake of carbohydrates. If the food is deficient in carbohydrates, the body becomes weak and less active.

The wrinkles appear on the outer surface and the development of internal tissues of the body gets also affected. The excess intake of carbohydrates causes diarrhoea, diabetes and obesity.

4.32. Symptoms of marasums. It is mainly due to undernourishment, that is less calorie and is cause due to deficiency of protein or carbohydrates or both. It shows following symptoms :

(*i*) Dehydration due to watery diarrhoea.

(*ii*) Subnormal temperature

(*iii*) Dull and dry hair

(*iv*) Continued feeling of hunger

(*v*) Low pulse rate

(*vi*) Acidic stools

(*vii*) The abdomen may be distended by gas.

4.33. Kwashiorkor. It is very common among the poor people particularly the beggars and labourers. Usually, a child getting less than 1 g protein per kilogram of body weight in a day suffers from this disease. It shows following symptoms :

Fig. A child suffering from Kwashiorkor

1. It seldom occurs before the age of 6 years.
2. The excessive fluid is retained in the intracellular spaces producing oedema.
3. Patchy skin lesions.
4. The face gives the appearance of moon.

4.34. Vitamins. The term vitamin was coined by Funk. They are required for normal growth and maintenance. Their presence in the food is very essential because many of them cannot be synthesized by the body.

4.35. Functions of vitamin A

1. It is found in the retina of the eye as visual purple. It is bleached in the presence of light and thus it enables us to see.
2. It secretes certain substances which keep the tissues moist and healthy.
3. It is essential for the normal development of epithelial tissues.

4.36. Symptoms of Vitamin A deficiency

1. The deficiency of vitamin A may cause Night blindness in which one is unable to see in dim light.
2. Deficiency of vitamin A cause xeroderma in which skin becomes dry, rough and scaly.
3. Deficiency makes the mucus membranes thin, dry, porous and flashy.

4.37. Symptoms of vitamin D deficiency. Deficiency of vitamin D causes mal-formation and distortion of bones in infants. The other symptoms are pigeon chest, enlarged wrists and ankles. The disease is termed as Rickets.

If the deficiency of vitamin D continues in the children as well, then it causes osteomalacia. It is characterised by poor calcification of bones with increasing softness, accompanied by rheumatic pains and exhaustion.

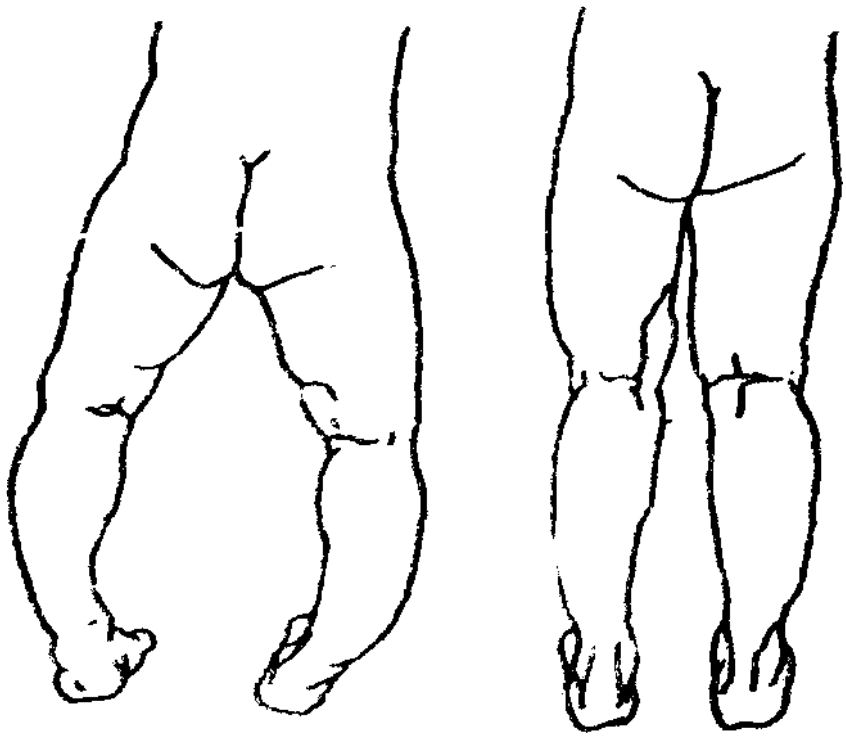


Fig. A Child suffering from rickets

4.38. Different vitamins grouped together as B-complex

1. Thiamine or vitamin B_1
2. Riboflavin or vitamin B_2
3. Nicotinic acid or niacin
4. Pyridoxine or vitamin B_6
5. Pantothenic acid
6. Biotin
7. Folic acid
8. Vitamin B_{12}

4.39. Source of Calcium. The sources of calcium are milk and milk products, green leafy vegetables such as spinach, amaranthus, carrot, peas, lemon, soyabean, pineapples, tomatoes and fish.

4.40. Effect of Calcium deficiency in the diet. The deficiency of calcium leads to the formation of fragile bones which break easily. It tightens the muscles and rheumatism, osteomalacia and osteoporosis are the final results of calcium deficiency.

4.41. Sources of iron. Liver, meat products and egg yolk are the important sources of iron. The green leafy vegetables, mango, date, banana have enough amount of mineral.

4.42. Effect of iron deficiency. The deficiency of iron leads to anaemia. The loss of haemoglobin in the body first effects the oxygen carrying capacity

of blood and later on it also reduces the rate of oxidation and energy formation in the body. The general symptoms are : pale skin, general weakness, headache, poor hair growth etc.

4.43. Sources of iodine in our food. Marine and deep sea fishes, brown red algae are the important sources of iodine.

4.44. Iodine is an important component of our diet. Iodine is an essential component of throxine which is secreted by throid gland. The deficiency of iodine causes goitre. Its symptoms are enlargement of thyroid gland, by hypertrophy swelling of neck bulging of eyes and falling of hairs.

Fig. Woman suffering from goitre

4.45. Table shows Vitamins, their sources, functions and deficiency diseases

Vitamin	*Source*	*Function*	*Deficiency disease*
A (Carotenoid)	Fish, liver, kidney, egg, milk, butter, carrots, spinach, all green and yellow vegetables.	Health of the eyes, skin, and mucous membranes	Night blindness, and xerophthalmia.
B_1 (Thiamine)	Cereals, wheat, cabbage, carrots, milk, spinach etc.	Growth and carbohydrate metabolism.	Beri-beri and loss of appetite.
B_2 (Riboflavin)	Liver, cheese, milk, egg, soyabean, green vegetables, etc.	Growth, health of skin and mouth, normal functioning of eyes.	Retarded growth, loss of hair, sourness of tongue and lips, premature aging.
B_6 (Pyridoxine)	Yeast, cereals, milk, egg, liver etc.	Growth, and metabolism.	Inflammation of the skin, mental disorders, loss of appetite.
B_{12} (Cyanocobalamine)	Liver, egg, milk, meat, fish, fruits etc.	Growth and blood formation.	Pernicious anaemia, slow growth.

Vitamin	*Source*	*Function*	*Deficiency disease*
C (Ascorbic acid)	Lemon, orange, grape, amla, tomato, apple, green vegetables etc.	Development of teeth and gums.	Scurvy.
D (Calciferol)	Animal fats, butter, ghee, oil, milk, egg yolk 'c.	Formation of bones and teeth.	Rickets.
E (Tocopherol)	Wheat, egg yolk, butter, milk, leafy vegetables etc.	Normal functioning of sex glands.	Sterility.
K (Phylloquinone)	Green vegetables, berry, tomato, soyabean etc.	Normal blood clotting.	Hemorrhage.

4.46. Minerals. They are present in small amounts and regulate various metabolic activities in our body. They are obtained either from the food that we eat or are directly taken along with water. For the normal functioning of the body, the following minerals are most important :

(*i*) **Calcium.** It builds bones and teeth of our body, regulates heart beat and muscle contraction; and helps in the clotting of blood. Calcium is mainly obtained from milk, green leafy vegetables, egg etc. Its deficiency results in weakening of bones, impaired heart beat and blood does not clot early.

(*ii*) **Phosphorus.** Along with calcium, it helps to build bones and teeth of our body. It is also involved in the energy transfer reactions of the body. Mainly found in cereals, pulses and milk. Its deficiency results in weakening of bones and teeth.

(*iii*) **Iron.** It is needed for the formation of haemoglobin and blood cells in our body. Therefore, it helps to transport oxygen from lungs to various tissues of the body. Mainly found in cereals, pulses, meat, green leafy vegetables, apple, guava etc. (Any cut fruit that becomes brownish after sometime contains lot of iron). In its absence very less new blood cells will be formed. This disease is known as anaemia. A person suffering from anaemia becomes pale, loses appetite and feels tired.

(*iv*) **Magnesium.** It regulates the functioning of muscles and nerves. Also acts as an activator for various enzymes. Mainly found in cereals and leafy vegetables. Muscles and nerves do not function properly in its deficiency.

(*v*) **Sulphur.** *It is involved in the formation of some proteins.* Cereals, pulses, methi, kala namak, leafy vegetables have sulphur. Muscles and nerves do not function properly in its deficiency.

(*vi*) **Iodine.** *It is essential for the normal functioning of thyroid glands in our body.* Mainly found in milk, fish, sea-water and haldi. Now-a-days we get *iodised salts in the market.* In its deficiency, the thyroid glands will swell up. *This condition is known as goitre.* It affects physical and metal growth of *children also.*

(*vii*) **Chlorine.** It regulates the working of nerves, stomach and various enzymes. Mainly found in common salt (sodium chloride), cereals, fruits and vegetables. Its deficiency results in dehydration of the body tissues and weakness of the body.

(*viii*) **Sodium and potassium.** They maintain the ionic and water balance of the body. Their deficiency may lead to dehydration (due to acute diarrhoea and vomiting), increased heart beat, kidney damage etc.

4.47. Water. About 90% of our body is composed of water. *In the absence of water, life becomes impossible. it performs the following functions in our body :*

(*i*) All the chemical changes in our body depend on water since it can dissolve most of the substances.

(*ii*) It carries all the nutritive materials to various parts of the body after the process of digestion.

(*iii*) It helps in maintaining a uniform temperature of the body.

(*iv*) Excreta and other metabolic wastes are removed from the body dissolved in water.

(*v*) It protects the body from external injuries.

(*vi*) It serves as a lubricant near the joints and thus protects them from friction.

TEXT BOOK QUESTIONS

Q. 1. What are the functions of foods ?

Ans. (*i*) Food is necessary to furnish the body with energy.

(*ii*) Food energy is used to perform various life activities.

(*iii*) Food helps our body to grow and to build new tissues which have been worn out.

(*iv*) Food is useful for growth and development.

Q. 2 What are some important functions of water in the body ?

Ans. (*i*) It acts as a medium of transport of various substances to the cells.

(*ii*) It excretes wastes outside the body and dilute waste products and poisonous substances.

(*iii*) It helps in maintaining body temperature by sweating and evaporation.

(*iv*) It helps in the formation of urine and faeces.

(*v*) It helps to moisten the food and provides moist environment required by cells in the body.

Q. 3. What is the main function of the digestion process ? Do the cells use the food in the same form as we eat ?

Ans. The main function of the digestive process is to change the complex food into the simpler food so that it may easily be absorbed by the intestine cells.

The cells do not use the foods in the same form as we eat. They absorb the food in the simple form after undergoing the process of digestion.

Q. 4. Which substance offers more energy when taken in same amount – fat or carbohydrate ?

Ans. Fat yields more energy as compared to carbohydrate when they are taken in the same amount. For example, one gram of fat gives 37 K joules, whereas one gram of carbohydrate gives 17 K joules when oxidized.

Q. 5. Name some types of proteins present in our body ? What are their functions ?

Types	*Functions*
(*i*) Enzymes	They act as bio-catalyst to enhance the rate of bio-chemical reactions.
(*ii*) Transport proteins	They carry different substances in the blood to different tissues.
(*iii*) Contractile proteins	These proteins help in the contraction of muscles.
(*iv*) Structural proteins	These proteins constitute the structural elements of cells and tissues.
(*v*) Protective proteins	These proteins form the anti-bodies to fight against disease germs.

Q. 6. Are the proteins, that we eat, used as such in our body ?

Ans. Proteins that we eat are not used as such in our body but these are changed into simplified form as amino acids. Proteins are broken into amino acids by the process of digestion. It involves the breaking of the peptide bond which join the amino acids of protein. These are then used by our body for growth of cells and tissues.

Q. 7. Why are carbohydrates and fats called energy food ?

Ans. Carbohydrate is the cheapest source of diet, consumed largely by the people. In generally, carbohydrates provide for 60 to 80% of total food energy in our diet. Similarly, fats provide the maximum amount of energy on oxidation as comapred to other food items. That is why, carbohydrates and fats are called as energy foods.

Q. 8. What are the major components of food ? Why are they called nutrients ?

Ans. The major components of food are: (*a*) Carbohydrates, (*b*) Proteins, (*c*) Fats, (*d*) Vitamins, (*e*) Minerals and (*f*) Water. These are called nutrients because each food diet contains varying amount of nutrients. For example, rice and maize contain maxium amount of carbohydrates and small amount of protein and fat. Similarly, meat and fish have more protein, but almost no carbohydrates. A balanced diet contains all the nutrients in correct amount.

Q. 9. How can glucose solution help a patient when he cannot eat ?

Ans. Glucose is given to the patient for a quick supply of energy. Glucose is a simple and open chained sugar which is readily assimilated by the patient and provides a quick supply of energy.

Q. 10. What are the three kinds of carbohydrates ? Do we digest all of them ?

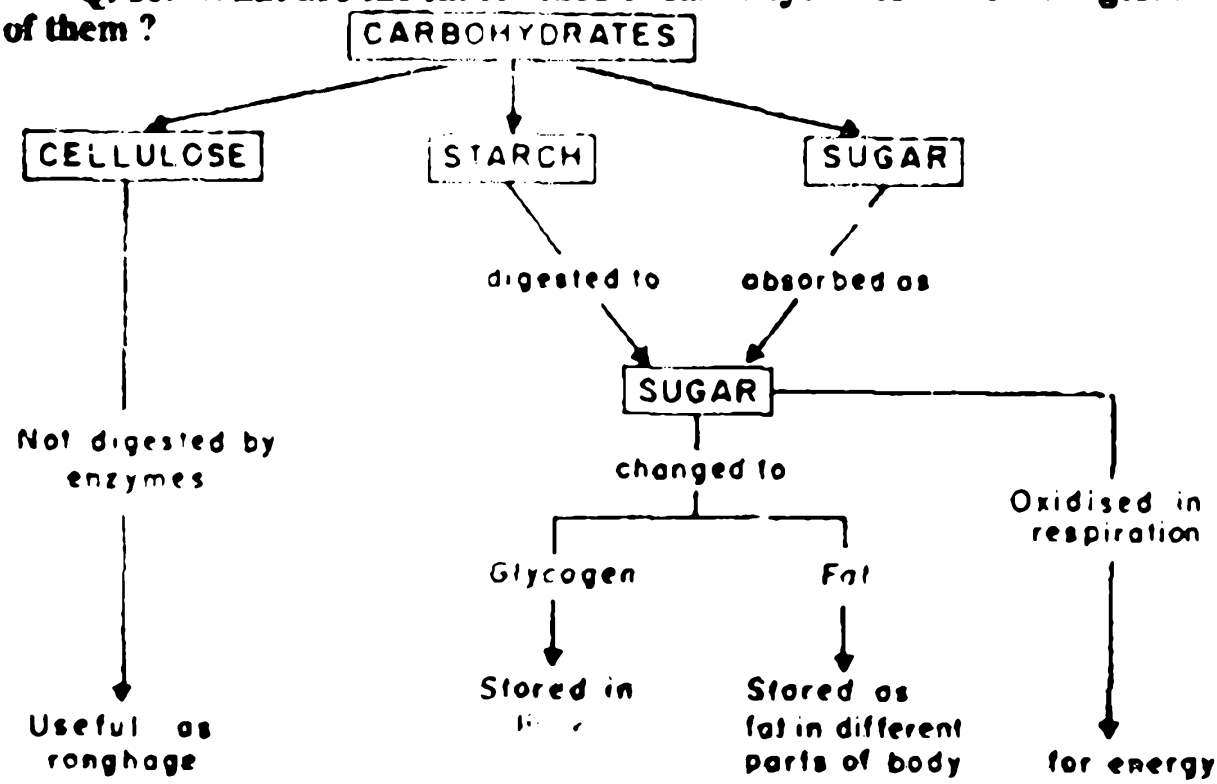


Fig. Charbohydrates we consume and their use in our body.

Ans. The three kinds of carbohydrates are :

(*i*) Cellulose (*ii*) Starch and (*iii*) Sugar.

Cellulose and starch are the polysaccharides which yield more than 6 molecules of monosaccharides, on hydrolysis. Sugar is the monosaccharide which cannot be hydrolyzed into a simpler form.

Sugar is absorbed as a sugar which is later on changed to glycogen and fat as a storage product.

Cellulose is indigestible in human body but starch is firstly digested to sugar before it is absorbed and stored in the body as glycogen and fat. We cannot digest the polysaccharides mainly cellulose as we lack the cellulose digesting enzymes. Thus, cellulose is used as roughage in our body.

Q. 11. What are forms in which the body uses 'carbohydrates' ?

Ans. Our body uses carbohydrates when it is converted to simple form (monosaccharides). The carbohydrates are acted by several enzymes in our body which hydrolyse the carbohydrates into simple and open-chained sugar like glucose and fructose. Thus, our body absorbs the carbohydrates in the forms of simple sugars.

Q. 12. Name some food items which are mainly starchy? What are the forms we make them in ?

Ans. The food items containing starch are :

(*i*) Potato (*ii*) Flour (*iii*) Rice and (*iv*) Maize.

We consume the starch in the form of rice, potato, bread or roti made out of wheat, sorghum or maize. Besides this, we take it in the forms of fruits, vegetable and other plant material (salad).

Q. 13. Why is carbohydrate-rich food more necessary for people doing hard physical labour ?

Ans. Carbohydrates are the major energy source of the body. This provides for 60% to 80% of total food energy in our diet. A person doing hard physical labour requires more energy and so carbohydrate-rich food can provide this energy. Secondly, carbohydrates are the cheapest which is taken in bulk in the diet.

Q. 14. Under which conditions a high protein diet is needed ?

Ans. A high protein diet is needed under the conditions of growth of tissues. Proteins are the body building foods which are required largely by children upto the age of 12 and the pregnant women.

Q. 15. What are saturated and unsaturated fats ? Name one food item having each kind ?

Ans. Saturated Fats. The fats which do not have any double bonds between the carbons of the molecular chain are known as saturated fats. They

are solid at room temperature e.g., palmitic, stearic acid and vanaspati ghee.

Unsaturated Fats. These are the fats containing one or more double bonds between the carbons of the chain. They have generally low melting point, e.g. ground nut oil, olive oil and mustard oil.

Q. 16. What kind of health hazards are believed to be associated with high saturated fat/diet ?

Ans. The high saturated fats are solid at room temperature. They get deposited in the arteries walls and cause the obstruction of normal blood flow. This leads to high blood pressure and heart diseases like arteriosclerosis (blockage of artery), and coronory attack.

Q. 17. What is dehydration of tissues or cells ? Why should one drink water after heavy sweating ?

Ans. Dehydration of tissues or cells means loss of water after hard physical labour or during sweating in summer. Water acts to regulate the body temperature by sweating and evaporation. So, one drinks water after having sweating in order to compensate the loss of water and to regulate the body temperature, digestion, excretion and transport.

Q. 18. Why should the food contain some roughage material ? How does it help ? Name some sources of roughage in our food ?

Ans. The roughage is generally constituted by indigestable plant cellulose. Our food should have some roughage material because it helps in retaining water, adds bulk to the food and prevents constipation. Roughage are required to maintain proper digestive system.

The important source of roughage in our food are salad, vegetables, fruits with stems, corn cob (bhutia), and half-broken wheat (dalia).

Q. 19. What is a 'balanced diet' ? Is it the same for all age groups and professions ?

Ans. Balanced diet. A diet is said to be balanced if it contains correct proportionate amount of proteins, fats, carbohydrates, minerals, salts, water and vitamins contents necessary to meet the nutritional requirements of an organism for growth and development.

Balanced diet is not the same for all age groups and professions

Q. 20. Does the diet depend on special needs ? Give two examples ?

Ans. Yes, the diet of an individual depends on the special needs. For example, the pregnant women require extra quantity of amino acids, calcium, iron and sufficient vitamins to carry out healthy building processes for developing child in their womb. The amino acids are essential for tissue growth, calcium for bones and iron for blood. Similarly, a developing child

upto the age of 12, requires more as compared to his body weight. He needs surplus supply of protein, calcium, iron, vitamin D and C to build healthy body.

Q. 21. Why should a pregnant woman get high protein and energy-rich food ?

Ans. A pregnant woman should get high protein and energy-rich food for the proper development of baby within her womb. The developing embryo depends completely on the mother for its nutrition. A pregnant woman should take high protein to build the healthy tissue growth of her baby. Similarly, high energy-rich food is necessary for the mother to meet the increased nutritional requirement of the embryo. If the pregnant woman is deficient of some basic materials like proteins and iron etc. then the developing embryo will suffer from certain abnormalities.

Q. 22. Why is mother's milk best for the baby ?

Ans. Mother's milk contains sufficient amino acids and fatty acids for the tissue growth of the baby. The mother's milk is best for the baby because it supplies the baby with active protective antibodies to fight against the diseases.

Q. 23. Name some elements the protein molecules have other than carbon, hydrogen and oxygen.

Ans. The elements of protein molecules other than carbon, hydrogen and oxygen are nitrogen and sulphur.

Q. 24. What element does haemoglobin has and what is its function ?

Ans. Haemoglobin contains the iron element.

Iron is very essential element in the formation of haemoglobin. Its deficiency leads to anaemia.

Q. 25. Why are vitamins and minearals necessary for life processes ?

Ans. Vitamins and minerals are necessary for proper growth and to regulate the different metabolic activities of the body. The deficiency of vitamins and minerals causes retarded growth and various disorders. For example, the deficiency of vitamin A leads to night blindness and Vitamin B_{12} results in anaemia. Similarly the deficiency of vitamin D causes rickets in children and osteomalacia in adults. Thus, the vitamins are required for the maintenance of health. Though, they have no energy value, yet they prevent the individuals from several deficiency disorders.

Similarly, the minerals are necessary for the metabolic activities of the body and construction of certain tissues. They are necessary to build bones, teeth (Ca and P); in blood coagulation, muscle contraction and relaxation (Ca); formation of red blood cells (Fe) and in thyroid gland activity (I_2).

Q. 26. Can we make any vitamins in our body ? Name the vitamin which can form due to interaction of sunlight and fat under the skin ?

Ans. Generally, our body cannot make vitamins except vitamins D and K. Vitamin D is formed due to interaction of sunlight and fat under the skin.

Q. 27. Which vitamin exists in large amount in citrus fruits ? Is it water soluble or fat soluble ?

Ans. Vitamin - C exists in large amount in citrus fruits. Vitamin - C is a water-soluble vitamin.

Q. 28. Fill up the blanks :

(*a*) Vitamin ..... deficiency results in scurvy.

(*b*) Deficiency of riboflavin results in .....

(*c*) Night-blindness can occur due to vitamin ..... deficiency.

(*d*) Vitamin D deficiency leads to .....

(*e*) Anaemia may result due to vitamin ..... deficiency.

Ans. (*a*) C (*b*) ariboflavinosis (*c*) A (*d*) rickets and osteomalacia (*e*) B_{12}.

Q. 29. Why are salts iodized ? Why is goitre not seen in sea sides ?

Ans. The salts are iodized to make the deficiency of iodine in the food. Iodine is an important component of hormone-thyroxine, secreted by thyroid gland. The deficiency of thyroxine leads to various mental disorders and retarded growth. Thus, iodized salts are helpful in restoring the normalcy of thyroid gland and in turn, thyroxine.

The goitre is not observed in seacoast people, because they cosume the sea food which contains the high amount of iodine.

Q. 30. What are the reasons for getting kwashiorkor ? How can it be prevented ?

Ans. Kwashiorkor is caused by the deficiency of protein when breast feeding is replaced by less nutritive food. It is usually observed in babies who are weaned from protein-rich milk to other diets, mainly by taking carbohydrate diet.

Kwashiorkor can be prevented by consuming protein-rich diet such as combination of wheat, gram, peanuts, soyabean and jaggery or diet with animal protein.

Q. 31. What is obesity ? Is it a health hazard ?

Ans. Obesity is a condition where a person takes more energy food than the body needs. As the age advances, low energy is utilized as a result small amount of food is required. But many people continue to take same amount of food as consumed in the earlier years and cause the surplus food to get

accumulated in the body. This extra food turns into fats causing obesity in many people. Sometimes, obesity can result due to hormonal imbalance or other metabolic malfunctioning.

An excessive weight (obesity) is considered as a persistent health hazard because fat people tend to have high cholesterol deposition which leads to cardio-vascular diseases like heart-attack, hypertension and arteriosclerosis, etc.

Q. 32. Why should one eat green leafy vegetables ? Name some vitamins and minerals present in them.

Ans. One should eat green leafy vegetables because they are the important source of vitamins and minerals. Vitamins and minerals are necessary for proper growth and to regulate the different metabolic activities of the body.

The green leafy vegetables contain the following vitamins and minerals.

Vitamins - Vit. A, B_1, B_2, B_4, folic acid and vit. E etc.

Minerals - Calcium, potassium, magnesium, iron and iodine.

Q. 33. Is groundnut more nutritious than water or wheat ? What nutrients does it contain ?

Ans. Yes, ground nut is more nutritious than water or wheat. Groundnut is an item which has both protein and energy nutrients (*fats and carbohydrates*) in large amount.

Q. 34. Name some factors which leads to loss of nutrient value ?

Ans. (*i*) Deep frying or prolonged heating results in loss of nutrients and vitamins.

(*ii*) Some water-soluble vitamins like vitamin C are lost when they are soaked in water for long period.

(*iii*) Vitamins C are oxidised when fruits and vegetables are left out for long time.

(*iv*) Some grains lose their nutrients when they are washed.

(*v*) The husked pulses and cereals are more nutritious than dehusked ones.

(*vi*) Faulty cooking method may also lead to loss of nutrients.

(*vii* Endemic nutritional deficiences may occur due to biological factors or geographical factors.

Q. 35. What is food habit ? Is it necessary to change sometimes ?

Ans. The persons are habitual to consume different types of food depending upon their taste and availability of raw food materials. This is known as food habit. Some people eat rice whereas others as roti. The coastal region like to take fresh and dried fish. Thus, food habit changes from region to region depending upon their availability.

The food habit should change sometimes but it should be a 'balanced diet', having the proper nutritive value as per requirement of the body.

FOOD PRODUCTION

5.1. Auto-trophs. The green plants are autotrophs as these organisms can prepare their own food from air, water, nutrients and sunlight.

5.2. Hetrotrophs. The non-green plants and all animals except Eugiena are hetrotrophs as they depend upon other plants and animals for their food.

5.3. Agricultural practices and the implements used.

S.No.	*Agricultural Practices*	*Implements Used*
1.	Preparation of soil *(i)* Ploughing *(ii)* Levelling *(iii)* Manuring	Plough : wooden and iron Leveller : wooden and iron Manual application or drill. Ploughs, hands sowing, use of bullocks or machine operated seed drills.
2.	Sowing	Manual (drill) Kassi (trowel)
3.	Application of fertilizers	*Khurpa (Harrow)*
4.	Irrigation	Manual sprayer, mechanical
5.	Weeding	sprayer, serial spray,
6.	Crop protection	(aircrafts, helicopters).
7.	Harvesting	Sickle, harvesters.
8.	Threshing	Animals, threshers, combines.
9.	Storage	Wooden, clay and metallic bins.

5.4. Utility of soil in agriculture. Soil is a natural dynamic medium in which a number of physical, chemical and biological activities are taking place continuously.

1. Soil provides space to plants.
2. Soil holds them strongly to provide enough support.

3. Soil provides oxygen to roots through its pores.

4. It provides nutrients and water to the growing plant and helps anchor their roots.

5.5. Processes through which soil nutrients are lost. The soil nutrients are lost by

1. Soil erosion by floods and winds in the absence of forests,
2. Over-cropping, and
3. The leaching of mineral nutrients.

In the arid region, there is no leaching because of absence of water. But such regions accumulate soluble minerals on their surface or beneath and cause salinity.

5.6. Natural process for restoring fertility.

(*i*) the fixation of atmospheric nitrogen by nitrogen-fixing bacteria (Azotobacter, Rhizobium and Clostridium) in the leguminous crops and by some blue-green algae etc.

(*ii*) by the process of leaf-fall, production of animal and plant wastes and the decomposition products of animal and plant bodies.

5.7. Artificial means to maintain soil fertility. Artificially, the soil fertility is maintained by the supplementary addition of nitrogenous and other fertilizers, bio-manuring and by crop-rotations.

5.8. Soil erosion. The removal of top fertile soil by various agents like water and rain is known as soil erosion.

5.9. Cause of soil erosion

(*a*) By man's activities like urbanization, cutting down of forests and mining.

(*b*) By wind.

(*c*) By rain water which makes weak carbonic acid causing the pulverization and dispersal of rock material.

(*d*) Ice, glaciers and ocean waves.

5.10. Checking of soil erosion. The soil erosion can be checked by

(*a*) reforestation, because the roots of the plants hold the particles of top soil firmly and thus, wind or water cannot carry away the top fertile soil.

(*b*) growing of tall trees at right angles to the direction of wind also helps to prevent soil erosion.

(*c*) shifting cultivation and urbanization of rural areas should be stopped.

5.11. Macronutrients. Nutrients which are required in large amounts are called macronutrients. For example C, H, O, N, S, P, Ca, Mg etc.

5.12. Micronutrients. Nutrients which are required by the plants in traces are called micronutrients or trace elements e.g., B, Mn, Mo, Zn etc.

5.13. Plants obtain carbon, oxygen and hydrogen

Carbon from CO_2 in air.

Oxygen from air and water.

Hydrogen from water.

5.14. Broadcasting. Sowing the seeds manually into the soil is called broadcasting.

5.15. Legume crops. Gram, soyabean, berseem, arhar.

5.16. Granular fertilizer. Potassic and phosphatic fertilizers.

5.17. Sources of irrigation. Canals, wells, tubewells, ponds and rivers.

5.18. Weeds. Unwanted crop plants grown with the crop plants are called weeds.

5.19. Weedicides. The chemicals which destroy the weeds are called weedicides.

5.20. Fungal diseases of our cereal crop. Rust and smut.

5.21. Diseases of paddy crops. Blast of rice.

5.22. Pest of Paddy Crops. Gundhy bug.

5.23. Pest of Cotton Crop. Pink boll worm of cotton and spotted boll-worm of cotton.

5.24. Hybridization. The process of cross breeding of two varieties is called hybridization.

5.25. HYV. High yielding varieties.

5.26. Threshing. Separating the grains from chuff is called threshing.

5.27. Winnowing. Cleaning the grains which is ready for storage is called winnowing.

5.28. Bad effects of excess fertilizers. Excessive use of fertilizers affects soil fertility and human and animal health.

5.29. Green fodder plants for animals used in water. Barseem and lucerns.

5.30. Main food component obtained from fishes. Proteins.

5.31. Vast infrastructure which support modern agriculture. They are industries to produce farm implements, pumps, fertilizers and pesticides, irrigation and power are projects, research and development institution for better yielding of crops and animals.

5.32. Role of soil for propagating the plants. Soil is a medium which provides nutrients and water to the growing plants. It helps anchor the roots. Soil provides oxygen to the roots through aeration. It supports and protects the living beings.

5.33. Multiple Cropping. Growing and raising two or four crops in succession in a year in the same field is termed as multiple cropping. For multiple cropping low duration crops are selected and proper irrigation facilities should be available.

5.34. Eutrophication. Some nitrate concentrated water promotes the growth of algae which deplete the water by its content resulting the death of the organisms of water. This type of deadening of the life supporting environment in lakes or ponds due to lack of oxygen content is called eutrophication.

5.35. Seed borne diseases. These diseases are transferred through seeds, for example, Red rot of sugarcane, bacterial blight of rice.

5.36. Air borne diseases. These diseases are spread through oil for e.g., blast of rice, coffee dust.

5.37. Soil borne diseases. These diseases are spread through soil, e.g., smut of bajra.

5.38. Good health of Cattle can be maintained. For good health of cattle, a well-designed shelter is required. It reduces the incidence of diseases. Frequent bathing and grooming of cattle help in maintaining the good health.

5.39. Process of sowing. After the soil is prepared, the seeds are sown into it. This is done by two methods :

(*i*) sowing by hand or broadcasting; and

(*ii*) sowing with a seed drill. Seed drill basically is funnel-like opening connected to several long tubes. By this method seeds are sown at correct depths and at regular intervals.

5.40. Raising seedling in nursery. The method is adopted for the seeds of paddy and certain vegetables. Seeds are sown in the nursery before being transferred to the main field. For this a fertile, well-drained land is selected near the main field of irrigation. Soil is ploughed, watered and made weed free. Adequate manure or fertilizer is added and soil is made soft and fertile. For protection of seedlings from insects and disease causing organisms – parathion, demacron, thiodie etc. – are sprayed over the seedlings.

5.41. Transplantation. Transfer of seedlings from nursery to the main field is called transplantation. Before transplanting, the field is thoroughly ploughed deep and exposed to the sun rays that kills the eggs or larvae of harmful insects, pests and weeds. The field is also flooded with water. This should be done two weeks before transplanting of seedlings.

For transplantation, the seedlings are uprooted from the nursery at the proper time. Delayed transplanting leads to poor tillering, early flowering and reduction in the yield.

5.42. Multiple and mixed cropping. With scientific farm management proper selection of crop and adequate utilization of land it is possible to obtain three or four crops in a year from the same field. Two main considerations to this are : (*i*) proper irrigation facilities (*ii*) selecting of early maturing varieties wider use of mixed cropping not only solves the food problems but also improves the economy of the farmers.

TEXT-BOOK QUESTIONS

Q. 1. List of sources of our food. Categorise them into plant and animal sources ?

Ans. There are two major sources of our food. The crop plants provide us wheat, rice, maize, barley. The pulses are in the form of gram, pea, nuts. The oil seeds are in the form of sunflower, mustard, groundnut etc. There are various fruit and vegetables like lemon, orange, apple, mango, pineapple, carrot, radish, turnip, cauliflower, cabbage, brinjal, lady finger and so on that form an essential part of our food.

The animals also provide us food such as milk, eggs and meat.

Q. 2. What precautions should one take before sowing a crop ?

Ans. Seeds are susceptible to diseases producing organisms. Therefore seeds should be treated with suitable chemicals before sowing in order to control seed-borne diseases. The seeds should be sown at the right depth and spacing.

Q. 3 Mention sequentially the various agricultural practices ?

Ans. The Agricultural practices should be adopted in the following sequence :

1. Preparation of soil - by ploughing, Levelling and manuring
2. Sowing of seeds.
3. Application of fertilizers
4. Irrigating
5. Weeding
6. Crop protection
7. Harvesting
8. Threshing
9. Storage

Q. 4 *Define weeding. What tools are used for weeding ?*

Ans. Removal of weeds from the field of cereal crop is called weeding. Amaranthus is the most common weed which grows along with almost every crop. Khurpa, Harrow etc. are used for weeding.

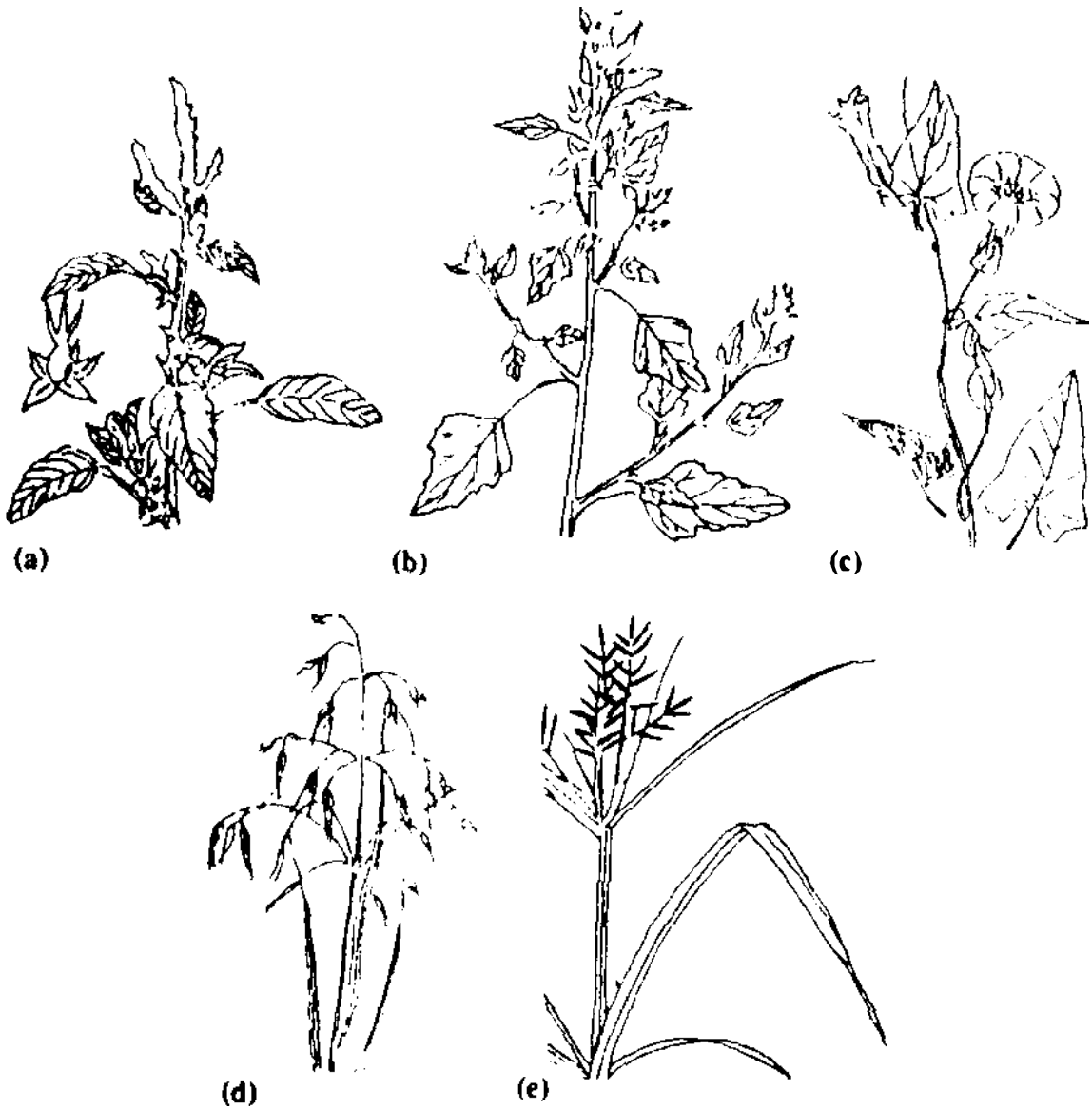


Fig. Common weeds : (a) Amaranthus (b) Chenopodium (c) Convolvulsus (d) Wildoat (e) Grass

Q. 5 What is a pesticide ? Why do we use pesticides ?

Ans. *Pesticidies are the chemicals which control the pests and protect* the crops. They are 'Fungicides' and 'insecticides'. They are used to increase the yields by killing the pests.

Q. 6 Why do we irrigate our crops ?

Ans. We know that water is very much important element of the living organisms to support life. Our crops need water in one or the other way. Their roots neither grow in a dry soil nor in water logged soil. Crops require specific amounts of water at different stages of their growth and ripening. Water is

essential for germination of seeds. Some irrigation systems like SHARDA SHAYAK have beneficial effects on the crops. Some salts and nutrients are available to the plants due to irrigation.

Q. 7 What is a fertilizer ? How is it different from manure ?

Ans. The nutrients in concentrated form to maintain soil fertility and to enhance the yields are called fertilizers.

Fertilizer	*Manure*
1. They are in concentrated form.	Manure is an organic substance obtained from decomposition of vegetable and animal waste.
2. Microbes are not needed.	Microbes are needed to degrade the organic substances.
3. They are easy to transport.	Difficult in transportation.
4. Easy to store and apply to crops.	Difficult to store and apply to crops.
5. They do not restore soil texture.	They restore soil texture.
6. They are not for better aeration and retention of water.	They are for better aeration and retention of water.

Q. 8 Name two fertilizers.

Ans. (*i*) Urea (*ii*) Superphosphate.

Q. 9. How has the uses of fertilizers improved crop production ?

Ans. Use of fertilizers compensate for replenishing soil nutrients. The nutrients may be depleted by continued use of the land for growing crops. Thus to maintain soil fertility the amount or dose of nutrients in the form of chemical fertilizer is necessary. They increase the yield of the crops.

Q. 10 Name the 3 high yielding varieties of

(*i*) Wheat (*ii*) Rice.

Ans. High yielding varieties.

(*i*) Wheat - Sharbati, Sonara, Kalyan sona, Rojo-64.

(*ii*) Rice - Basmati T-23, Jaya IR-8.

Q. 11 What is animal husbandary ?

Ans. The branch of agriculture which is mainly concerned with the breeding, feeding and caring of domestic animals is called animal husbandry.

Q. 12 What are work animals ? Name any two.

Ans. Work animals are those animals which are used for transport and labour e.g. Horse and Donkey.

Q. 13 List the practices necessary for raising animals for food.

Ans. Following practices are necessary for raising animals for food :

1. Feeding (*a*) Food (Providing proper food)
   (*b*) Water (Providing clean water for drinking).
2. Providing shelter
3. Protection against disease
4. Looking after their needs.

Q. 14 What is roughage ? From where animals obtain it ?

Ans. The fibrous coarse low nutrient straw material are collectively called 'roughages'. The animals obtain the roughage from green fodder and dry grasses. Maize and luceins act as roughages for them.

Q. 15 How does food affect yield in dairy animals ?

Ans. The milk yield of a milk animal is mostly determined by the type of feed given to the animal. In our country, the overall low yield of milk is due to poor quality of food material; as it is about half a litre per day for a cow and 1.5 litre for buffalo in comparison to 8 to 11 litres per day for a cow in some of the advanced countries. A cow on average requires 15-20 kg of green fodder and dry grasses, 4 kg of grain mixture and 32 litres of water every day.

Q. 16 Name the grains used for poultry feed.

Ans. The grains used for poultry feed include those of bajra, wheat and maize.

Q. 17 What are the characteristics of a good animal shelter ?

Ans. A good animal shelter should be

1. Well-lighted.
2. Proper ventilation
3. Proper water supply system
4. Hygienic disposal of excreta
5. Protected against weather, predators and diseases.

Q. 18 Name any two diseases of the animals caused by bacteria and viruses.

Ans. Animal diseases caused by bacteria :
Rinderpest in cattles, Tuberculosis in cattle.
Viruses Pox : Cow, buffalo, sheep, goat.

Q. 19 Name two high milk yielding breeds of cow.

Ans. Frieswal, Jersey.

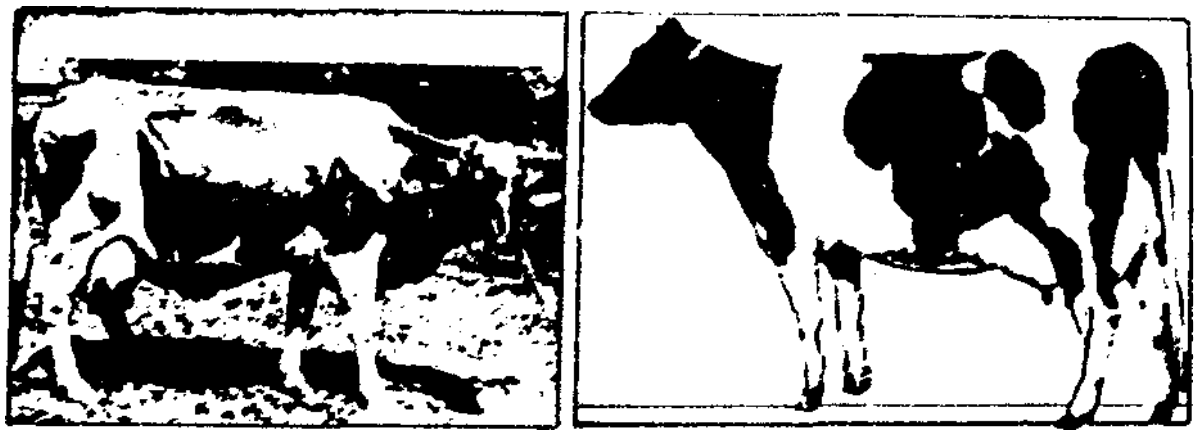


Fig. High milk yielding breeds of cow : (a) Friesian-Sahiwal (b) Hollstein-Friesian

Q. 20 What is artificial insemination ? State its advantages.

Ans. The process of introduction of semen of a male healthy and disease resistant bull into the female uterus through genital tract by artificial means is called artificial insemination.

Advantages of artificial insemination :

1. Healthy and disease resistant varieties may be produced.
2. Difficulties of transportation of animals overcome.
3. It is economical.
4. Semen from a single bull is usually sufficient for impregnating about 3000 cows.

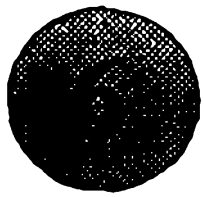
Q. 21. What characteristics should be taken into consideration for animal breeding ?

Ans. Following characteristics should be considered for animal breedings :

1. Selection of healthy and disease resistant male (bull)
2. Lactation period
3. Reproductive period
4. Nutritional requirements
5. Tolerance of climatic conditions
6. Resistance of disease
7. Quality of animal.

Q. 22 Name two varieties of marine and fresh water fish ?

Ans. Marine fish mackerels sardines, fresh water fish Catla, Rohu, Labeo, Barbus, Mystus, Cirrhiness, Channa, Tinca cyprinus etc.



MANAGEMENT OF FOOD RESOURCES

6.1. Planning. It is a scheme that includes all the critical steps through which we get a desired objective. In fact it is plan of action leading for the achievement of desired objective.

6.2. Characteristics of good plan. A good plan is based on the following characteristics :

1. It is based on reliable estimates of inputs available for the realisation of each step.
2. It also provides an imaginative organisation of the various steps which minimise the gap between the desirable and attainable.

6.3. Setting of annual production targets for major agricultural crops. These are set in the light of anticipated needs and estimates of available resources e.g. cultivated area, irrigation facilities and new additional inputs. Further, we proceed to find out how additional resources in irrigation, power, quality seeds, fertilizers and insecticides, storage and transportation needed.

6.4. Setting procurement targets in planning of food resources. The procurement targets are set in the light of need for renewing and building buffer stocks. These stocks of food resources are stored in godowns throughout the country.

6.5. Importance of food stored in godown. The stock of food resources stored in godowns throughout the country are our insurance against drought floods, blight and price fluctuations. It is helpful for supply to distress areas without any delay.

6.6. Four targets in planning food resources. Production, procurement, storage, transportation and distribution.

6.7. Flood. It is rise in water level downstream of a river due to rainfall and water flows out of river.

6.8. Monitoring progress of weather elements. The monitoring progress of weather elements means to control or direct weather elements for providing crucial information for timely intervention.

6.9. Important decisions that determines the final output. The knowledge of rainfall distribution in a region can be used to forewarn of drought. It also provides an idea to estimate the amount of solid moisture which is available and useful for plants. According to soil moisture, we selected the most appropriate crops that would be sustained and adapted at that place.

6.10. Factors which must be taken into account for deciding the time for harvesting crops. The following factors must be taken into account for deciding the time for harvesting.

1. The expected time of maturity – the crop must be matured, i.e. it has taken all utilisable reserves from the mother plant.
2. The likely time gap between production and utilisation.
3. The modes of packaging and storage.
4. Transport and distribution systems.
5. The moisture content should not be higher than required for safe storage to a particular crop.

6.11. Lead is not used for storing food materials. Lead is a poisonous metal. It reacts with food material. It causes food poisoning. Hence, it should not be used for storing of food material.

6.12. Copper should not be used for citrus fruits. Generally citrus fruits react with copper metal and produce some toxic compounds because these fruits contain acids. Hence, copper should not be used for citrus fruits.

6.13. Infestation. Generally insects, worms and micro organisms spoil or damage the food material in a storage. An attack of these organisms on food material is termed as infestation.

Some common insect pests which damage stored food grains are weevils, grain borer, red flour beetle, almond, moth, saw-toothed beetle and grain moth. They reduce nutritive value of grain and contaminate food material with webs, cocoons and dead remains.

6.14. Dry heating of food grains. The population and activity of bacteria, insects and micro-organisms increases with the moisture content in stored food grain. These organisms respire and release significant amount of heat. It raises the temperature of the grain. This is called as dry heating of food grains.

6.15. Wet heating or damp grain heating. Both high moisture content and high temperature accelerate the growth of moulds. The growth of mould increases the temperature upto 66°C and moisture content from 14% to 18%. This is known as damp grain heating.

6.16. Essential features of storage structures. Storage structures should possess the following essential features :

1. It should be water and moisture proof.
2. It should be clean easily.
3. It should be able to provide protection against variations in temperature and humidity.
4. Conveniently located for receiving, issue and transportation of food materials.
5. It should be able to prevent entry of rodents, birds and other animals.
6. It should be free from insects.
7. Convenient for inspection of stored food grains.
8. Able to facilitate the use of pesticides for control of pests and micro-organisms.
9. Storage structure should be located away from sources of infection such as garbage dumping grounds, tanneries and chemical industries, kilns, flour and bone crushing mills.

6.17. EDB. Ethylene dibromide.

6.18. Fumigant act on stored grain. Fumigants are volatile chemicals and they vapourise killing the insects without affecting the grain. 3 ml of EDB would be sufficient to fumigant one quintal of store grain whereas 5 ml for paddy per one quintal. The certain ampoules of EDB wrapped in cloth are inserted little below the surface of the grain to be fumigated. Now the structure is made to be airtight.

6.19. Population of insects and micro-organisms controlled in stored food grains. The population of insects and micro-organisms is controlled by the following ways :

1. The store as well as food grain materials should be free from insect and micro-organisms.
2. The stored grains should be regularly checked to detect the presence of insects.
3. Pesticides and fumigants are used for controlling pests and insects if they are present.

6.20. Bait at home for rodent. The bait may be made at home by thoroughly mixing :

(*a*) Flour (cereals/millets)

(*b*) Sugar or jaggery

(*c*) Any edible oil, and

(*d*) Zinc phosphide

They are mixed in a definite proportion.

6.21. Precautions to adopt for safe handling of pesticides.

1. Pesticides should always be kept tightly closed in their original packages. It should not be kept in unlabelled containers, milk bottles and open vessels.
2. They should be stored in such places where the children could not approach.
3. While spraying the pesticides, the mouth should be covered with a suitable mask, arms with short sleeves, head and other parts of body with cloth.
4. The smoking should be avoided while pesticides are being used.
5. We should follow the direction of wind while spraying the pesticides.
6. Empty containers and bags should be destroyed after using pesticides.
7. The vessels used for mixing pesticides and clothes used during spraying are washed with soap and water.
8. We should always have a first-aid box while using pesticides.
9. The doctor should be called in case of poisoning.

6.22. Food processing. It is the process of changing food materials into a more readily usable form e.g. wheat is threshed and ground into flour which is used for several preparations.

6.23. Deep freezing. Deep freezing is a direct method for preservation. It is used to inactivate enzymes and inhibit bacterial growth. It is used for storing fruits, vegetables and perishable food materials.

6.24. Importance of food preservation.

1. It increases food supply during off-seasons also.
2. It decreases food wastage.
3. It increases storage period of food stuff.
4. To ensure food supply in distant areas throughout the country
5. It decreases dietary inadequacies.

TEXT-BOOK QUESTIONS

Q. 1 Select the single most appropriate answer from amongst the following alternatives ?

(*i*) For safe storage, the moisture content of food grains should be ?

(*a*) Less than 14%

(*b*) 16-18%

(*c*) 20-24%

(*d*) above 26%

(*ii*) Heating of damp grain in storage occurs due to :

(*a*) Infestation by insects

(*b*) Decrease in atmospheric pressure

(*c*) Decrease in humidity

(*d*) High moisture content and growth of moulds.

(*iii*) Sugar syrup is used for preservation of fruits because it

(*a*) kills the micro organisms present in them.

(*b*) helps to improve their taste and flavour.

(*c*) drains moisture to inhibit growth of micro organisms.

Ans. (*i*) Less than 14%.

(*ii*) High moisture content and growth of moulds.

(*iii*) Drains moisture to inhibit growth of micro-organisms.

Q. 2 What are the factors which determine maturity of grain before harvesting ?

Ans. Two important considerations are to be taken into account before harvesting.

1. The crop should be mature i.e. it has absorbed all utilisable reserves from the mother plant

2. The moisture content of the grain at the time of harvesting should not be higher than 14% to ensure safe storage. To test the moisture content of grain is to crush it between the teeth. If it cracks, the moisture content is just right for harvesting.

Q. 3. List any three advantages of adopting proper management practices for various food resources ?

Ans. An effective management system which will ensure that the basic needs of all sections of the population are fulfilled, involves a number of activities. These are planning, production, procurement, processing, packaging, transportation and distribution.

Planning fix annual production targets for major agricultural crops in different parts of the country. Procurement targets are set according to the need for renewing and building buffer stocks. Different kind of storage facilities ensures proper availability of food grains and vegetables and fruits at all places and in all seasons. It is also useful to face the adverse situations of floods and drought.

Q. 4 List post-harvesting measures essential for protecting cereals.

Ans. (*i*) The grains should be free from insects, diseases and foreign matter like weeds, stones and straw etc.

(*ii*) After harvesting, the grains should be inspected to check for infestation.

(*iii*) The excess moisture in the grains should be minimised by keeping them in sunlight.

(*iv*) Drying of grains should be done over plastic sheets or cemented floor so that they may not absorb moisture from the ground.

(*v*) The cereals should be allowed to cool to room temperature before storage.

Q. 5 Why do fruits and vegetables get damaged more easily than foodgrains ?

Ans. The fruits and vegetables get damaged more easily because their moisture content is more as compared to foodgrains. Secondly, they are also damaged due to faulty storage facility, improper handling and defective transportation facilities.

Q. 6 What precautions should be taken before storing foodgrains ?

Ans. (*i*) The foodgrains should not contain high moisture.

(*ii*) There should be a low temperature in the godown. The optimum temperature accelerates the growth of insects infesting foodgrains.

(*iii*) Damp grain heating should be avoided.

(*iv*) The grains should be free from an infestation due to insects and micro-organisms.

(*v*) Only one kind of grain should be stored in one godown or container.

(*vi*) The godown or container should be well-ventilated.

Q. 7 List any five factors which affect the foodgrain crops during pre-harvesting period.

Ans. (*i*) The high quality seeds and healthy saplings.

(*ii*) The treatment of seeds with fungicides and antibiotics.

(*iii*) The appropriate time for sowing and harvesting.

(*iv*) The timely supply of fertilizers and water.

(*v*) Control of weeds and harmful insects.

Q. 8 What are the essential features of a good store for foodgrains ?

Ans. (*i*) The store should be well-ventilated and easy to clean.

(*ii*) The ceiling and the floor should be smooth, without cracks and crevices.

(*iii*) The store should be water and moisture proof.

(*iv*) The store should prevent the entry of rodents, birds and other animals.

(*v*) It should be conveniently located for transportation of foodgrain.

(*vi*) It should be designed as such that the stored food material may be easily checked and inspected.

(*vii*) It should facilitate the easily use of pesticides to control pests.

Q. 9. Why is it essential to maintain fruits and vegetables at low temperature for their safe storage ?

Ans. The high moisture and optimum temperature are the two main factors which cause damage to the fruits and vegetables. The low temperature inhibits the growth of micro-organisms and inhibit the action of enzymes present in foods which, in turn, protects the fruits and vegetables against high moisture and optimum temperature.

Q. 10 Name two abiotic and biotic factors which damage

(*i*) foodgrains

(*ii*) fruits and vegetables during storage.

Ans. Food grains :	(*a*) Abiotic factors	(*i*) high moisture
		(*ii*) high temperature
	(*b*) Biotic factors	(*i*) Rodents
		(*ii*) insect pests (Rice-weevil)
Fruits and Vegetables :	(*a*) Abiotic factors	(*i*) high temperature
		(*ii*) material of the container
		(*iii*) high moisture
	(*b*) Biotic factors	(*i*) Birds
		(*ii*) Micro-organisms
		(*iii*) Animals

Q. 11 State two indicators of infestation by insects and micro organisms in stored food grains.

Ans. Stored food grains are spoiled and degraded by insects, worms, and micro organisms. An attack by these organisms is called infestation. The insects deplete the food materials of their nutritive components and contaminate them with webs, cocoons and dead remains.

The action of micro organisms on stored food grains may result in loss of weight, failure to germinate, discolouration, heating and production of toxins.

Q. 12 What is meant by dry storage ? Give examples of five food materials which can thus be stored.

Ans. Dry or non-perishable foods such as food grain flour, cereals, sugar and spices can be stored at room temperature. This mode of storage is called dry storage. The main requirement for storing dry food are that the place should be clean and dry, cool and dark, well ventilated and free from rodents and insects. The flour, cereals, sugar and spices keep well at room temperature and in tight containers. These protect them from dust, moisture and insects.

Q. 13 How is the population of insects and micro-organisms controlled in stored foodgrains ?

Ans. (*i*) Pesticides should be used either by spraying or by fumigation in the stored foodgrains.

(*ii*) Ethylene dibromide (EDB) ampoules wrapped in cotton or cloth should be inserted below the surface of grain. The whole godown should be made air-tight and left undisturbed when ampoules are broken in the food-grains.

(*iii*) Only one type of foodgrain should be stored in one godown.

(*iv*) There should not be any cracks and crevices in the roof or floor because these cracks provide home to the pest.

(*v*) The infected grains should be immediately removed from the godown.

(*vi*) The godown should be well-ventilated.

(*vii*) Fumigants like EDB and aluminium phosphide should be used because they are volatile chemicals which quickly vaporize by killing the pests without affecting the grains.

Q. 14 How does fumigation differ from spraying ?

Ans. Fumigation is a method to control the growth of insect population in stored grain. Fumigants are the volatile substances which quickly vaporize by killing the insects without affecting the grains, e.g., ethylene dibromide (EDB) and aluminium phosphide. Spraying is a technique to disinfect the storage product with pesticide before the arrival of fresh stock e.g., malathion, pyrethurm.

Q. 15 What is food processing ? What are its advantages and disadvantages.

Ans. Food Processing. It is the process of changing raw food materials into a more readily usable form as wheat is threshed and ground; rice is husked and polished.

Advantages

(*i*) It prevents the food from spoilage.

(*ii*) It maintains the nutritive value of food.

(*iii*) It helps in preservation and to be available throughout the year and at distant locations.

(*iv*) It makes the food delicious and tasty.

Disadvantages

(*i*) Food processing sometimes causes the loss of nutrients as they are processed. The processing of cereals results in loss of iron, thiamine, niacin and pantothenic acid. Similarly, milled and polished rice causes loss of iron and vitamin-B.

(*ii*) It causes the decrease of nutritive value of food.

Q. 16 Describe four methods of food processing.

Ans. (*i*) **Husking.** The harvested crop may often contain husk or other inedible matter. They are separated by the process of husking.

(*ii*) **Threshing.** This is the technique of separating the grain from the chaff.

(*iii*) **Polishing.** It is the dehusking of the cereals.

(*iv*) **Grinding.** It is the crushing of the grain to get flour.

Q. 17 How does food preservation help in ensuring food supply throughout the year ?

Ans. Food preservation results in increasing the storage period of food stuff and maintains the nutritive and food value of perishable material. This is done by cooking or canning and by inactivation of enzymes. This ensures the longer retention of food without spoilage which helps in food supplying throughout the year.

Q. 18 Describe the principles of preservation of fruits and vegetables.

Ans. (*i*) **Bactericidal.** In this method, the bacteria are completely inhibited either by cooking or canning.

(*ii*) **Bacteriostatic.** In this method, bacteria and enzymes are inactivated either by dehydrating, salting or by pickling.

Both the above principles cause the elimation of micro-organisms and create the unfavourable conditions for their growth and action.

Q. 19 List three common methods for preservation of fruits and vegetables.

Ans. (*i*) Dehydration. This method removes the water from fruits and vegetables and thus, inhibits the growth of micro-organisms which cause spoilage. This is done by keeping the fruits and vegetables in the sun or by controlled conditions of temperature and humidity.

(*ii*) Salting. Most of the fruits and vegetables are salted to remove water from the food material. This prevents their spoilage by inhibiting bacterial growth.

(*iii*) Deep-freezing. This method helps in activating the enzymes and inhibiting the bacterial growth.

Q. 20 How do salt and sugar help in the preservation of fruits and vegetables?

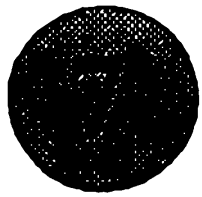
Ans. The spoilage in fruits and vegetables is caused by high moisture content in them. The high concentration of salt and sugar removes the water from food materials through osmosis and thus prevents their spoilage by inhibiting bacterial growth. The micro-organisms already present in fruits and vegetables die due to deficiency of water.

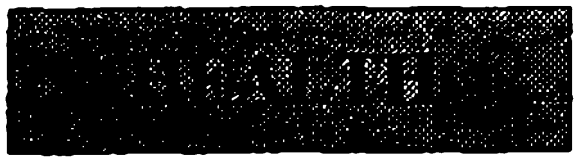
Q. 21 Name five fruits and vegetables which are preserved in salts and sugar.

Ans. (*i*) Raw mango
(*ii*) Amla
(*iii*) Tamarind
(*iv*) Beans
(*v*) Lemon
(*vi*) Chillies

Q. 22 Name three fruits which are generally used for preparation of jellies and pickles.

Ans. Jellies (*i*) Guava, **(*ii*)** Papaya, **(*iii*)** Pineapple
Pickles (*i*) Mango, **(*ii*)** Lemon, **(*iii*)** Amla, **(*iv*)** Jack fruit.





7.1. Conditions essential for maintaining good health.

1. The diet that we take must contain all the essential components of food in a definite proportion according to the age, sex and profession of the particular person.

2. We must keep ourselves, our clothes, utensils and our surrounding clean and hygienic.

3. Fruits and vegetables must be washed properly to remove pesticides and other chemicals adhering to the outer peels of these products.

4. We must use chlorinated or boiled water or filtered water to protect us from water borne disease.

5. We must breath only fresh air and it should not be polluted by smoke, fume and dust.

6. Regular exercise and rest are essential for the physical and mental fitness of a person.

7. We must keep ourselves away from bad habits of smoking, drinking alcohols and taking drugs.

7.2. Factors that affect our Health. There are two types of factors that affect our health. These are intrinsic factors and extrinsic factors.

The intrinsic factors are in the form of :

(*i*) Malfunctioning of any part of the body.

(*ii*) Improper functioning and secretion of harmones. Such type of diseases are called organic or metabolic diseases.

The extrinsic factors in the form of unbalanced diet or malnutrition, disease causing organisms, environmental pollution and use of cigarette, alcohol and narcotic drugs.

7.3. Some common diseases caused by various factors :

Factors	*Diseases*
1. Deficiency of protein	Marasmus, Kwashiorkor
2. Deficiency of vitamins	Nightblindness, Beri Beri, Pellegra. Scurvy, Rickets
3. Deficiency of minerals	Goitre, Hypertension, Fluorosis, Anaemia
4. (*i*) Diseases caused by Fungi	Ring worm, food poisoning
(*ii*) Diseases caused by virus	Poliomyelitis, chicken pox, leukemia, Measles, Rabies, Dengue, Hepatitis and AIDS
(*iii*) Diseases caused by bacteria	Pneumonia, Tetanus, Leprosy, Cholera, Tuberculosis
5. Diseases caused by protozoans	Malaria, Kala azar, Amoebic dysentry, Giardiasis
6. Diseases caused by chemicals	Silicosis, Asbestosis, Minamata
7. By smoke	Lung cancer, Bronchitis
8. By radiations	Cancer, skin injuries
9. Genetic disorders	Haemophilia, Sickle cell anaemia
10. Malfunctioning of organs	Cardiac failure, osteoporosis, Myopia, Cataract
11. Emotional stress	Hypertension, peptic ulcers, loss of memory.

7.4 Factors that account for obesity. Obesity results from :

(*i*) Genetic and metabolic and emotional disturbances

(*ii*) Over-eating, due to depreciation of love or frequently lose temper

(*iii*) Change in the environment and malfunctioning of glands.

(*iv*) Insufficient exercise

7.5. Excessive weight is a persistent health hazard.

An excessive weight is considered as a persistent health hazard because it leads to cardio-vascular diseases like heart attack, etc.

7.6. Obese person is looked upon as a poor risk by surgeon.

The surgeon as well as an insurance agent take obese person as a poor risk because majority of cases result into a premature death of the individuals.

7.7. Food Poisoning. When the food is contaminated with bacteria, fungi and their spores and they grow and reproduce by digesting the nutrients in the food making it unpalatable with unpleasant smell, the food poisoning occurs.

Micro-organisms grow extensively on the food and cause illness. In some cases they produce toxins (poisons) and cause disease. Generally food poisoning occurs by salmonella, staphylococci, closteridium botulinum and the fungus Aspergillus. Salmonella infects through meat, egg, milk and its products. Its multiplication intestine causes nausea, vomiting, diarrhoea and pain in abdomen. Heat-resistant staphylococci produces a toxin in the food. The food poisoning called botulism is caused by an anaerobic bacteria called Clostridium botulinum. The fungus aspergillus produces a toxin called aflatoxin on the food material. When the people take this poisonous food, they are infected. Generally, the food poisoning causes death, if not cared.

7.8. Aspergillus. Aspergillus is a fungus. It produces a toxin aflatoxin on grains like wheat, rice and maize. It specially grows on ground nuts when they are not properly stored. This toxin causes liver damage.

7.9. Antibiotics. The antibiotics are those chemical substances which are produced by one micro-organism and it kills or stops the growth of any other micro-organism.

7.10. Elephantiasis. The elephantiasis is a disease caused by filaria worm. It is transmitted by mosquitoes. It is the enlargement of certain parts of the body, particularly the legs, that resemble the legs of the elephant due to the repeated infection.

7.11. Symptoms, preventive measures and treatment for rabies.

Rabies is identified by hydrophobia i.e. fall of water, severe headache, high fever, pulse is frequent and saliva runs from mouth.

The disease is caused by the bite of dogs or wolves. So, the wound should be washed with carbolic acid or silver nitrate or potassium permanganate. A series of 14 injections is to be given if the dog dies within two days.

7.12. Genetic disorders. Those diseases which are transferred from one generation to another generation through genes, are genetic disorders. Haemophilia is a genetic disorder. A haemophilic person bleed profusely even on a cut or small injury.

7.13. Metabolic or organic or degenerative diseases. These diseases are caused by the malfunctioning of the vital organs like the heart, lungs and central nervous system. These are non-communicable diseases which affect only person who is suffering from it.

7.14. Coronary Heart Disease. This is caused by the deficiency of an insufficient blood to the heart muscle. This is due to the deposition of fat-like substance in the walls of arteries, rupturing of arteries or formation of clot. This reduces the supply of oxygen and nutrients to the heart which leads to the structural collapse, haemorrhage and finally to an acute heart attack.

Patients are advised to avoid fat, tea, coffee, alcohol and tobacco. Obesity should be reduced and no physical stress and strain be exercised by the patient.

7.15. Cancer. It is an unorganized and uncontrolled growth of cells in which controlling and regulating mechanisms have disappeared. The cells which normally divide themselves in a controlled manner suddenly proliferate in the tissues forming large growing tumors. The tumors cells separate from the tumor and migrate through blood stream to the other parts of the body and form secondary tumor. This condition may cause the death of the organism.

The common carcinogenic agents are nicotine, caffeine, steroids, arsenic, viral infection or ionizing radiations. Cancer can be cured with the help of surgery, radiations or certain chemicals if detected at the early stage.

7.16. Diabetes mellitus. It is characterized by the presence of excess quantity of sugar in the blood and its excretion in the urine. It is associated with a faulty functioning of islets of Langerhans in the pancreas which secrete an insulin. Patient feels thirsty and hungry, and excess urination takes place. Insulin injection and limited sugar in the diet can control this disease at some extent.

7.17. Haemophilia. It is a rare disease characterised by prolonged blood coagulation time and abnormal bleeding. Generally, clotting of blood does not take place.

7.18. Sickle cell anaemia. The red blood cells assume sickle-like shaped by change in the composition of haemoglobin molecule and their oxygen-carrying capacity is greatly reduced.

7.19. Communicable diseases. The diseases which spread rapidly from one person to another by any means, are called communicable diseases.

7.20. Communicable diseases caused by virus. Small pox, influenza, polionyelitis, chicken pox, AIDS, measles, conjunctivities, rabies, dengu, numps and hepatitis.

7.21. Communicable diseases caused by bacteria. Pneumonia, tetanus, tuberculosis, leprosy, cholera, food poisoning, typhoid, meningitis, syphilis, gonorrhoea.

7.22. AIDS. Acquired Immuno-Deficiency Syndrome.

7.23. Name of antibiotics. Pencillin, tetracycline, streptomycin, terramycin, chloromycetin.

7.24. Organism exposed to radiations. There will be genetic changes, cancers, skin lessions and chromosomal defects.

7.25. Contributors to the pollution of water. Sewage, oil, industrial and agricultural wastes.

7.26. ORS. Oral Rehydration Solution.
Mixture of salt, sugar and water.
7.27. Gaseous pollutant. CO_2, SO_2, CO, H_2S.
7.28. IMR. Infant mortality rate.

TEXT BOOK QUESTIONS

Q. 1. When will you call a person healthy ?

Ans. A person may be called healthy when he represents a vital and smiling face and has physical (fit body), mental (happy and clear mind) and social (ability to get along well with environment) development.

Q. 2. Give two examples how health of a person can depend on his environment.

Ans. The following two examples provide a support for that a person can depend on his environment.

(*i*) A healthy person should possess the ability to get along well with others (environment). The environment contaminated with disease causing micro-organisms affects health, e.g. water contaminated with vibriocholerae spreads cholera.

(*ii*) Unhealthy environment e.g. (air polluted with sulphur dioxide and hydrogen sulphide) affects our respiratory system and finally we become unhealthy.

Q. 3. Can you stay well if your home is clean but your neighbourhood is not, if not why ?

Ans. We cannot stay well if our neighbourhood is not clean. If our neighbourhood is not clean, our environment becomes unhealthy. It provides socially unacceptable habits. Unhealthy environment (environment or neighbourhood with dirt, garbage, micro-organisms and so on) represents unhappiness, hostility and bad social habits.

Q. 4. If you were the Chairman of the local municipality, what measures would you take to ensure community health ?

Ans. If I will be the Chairman of municipality I will take the following steps to improve community health :

(*i*) Proper sanitation in the surrounding environment.
(*ii*) Proper disposal of sewage from home to municipal sewer system.
(*iii*) Providing safe, germ free water for drinking.
(*iv*) Control on the spread of communicable diseases by isolating the patients.
(*v*) Family welfare.

(*vi*) Timely vaccination.

(*vii*) Proper treatment of the disease.

(*viii*) School health scheme for guiding student and parents for proper upkeeping of the children.

(*ix*) Proper community health education.

(*x*) Nutrition education for proper maintenance of health which can tell what type of food is more nutritious and builds general body resistance.

(*xi*) Better health and maternity services.

Q. 5. What is meant by nutritional disease ? Name a few and their causes.

Ans. Nutritional disease. A disease which is caused to nutritional deficiency (nutrition is deficient of food constituents viz. carbohydrate, protein, fat, minerals and vitamins) is known as nutritional disease.

The following are the nutritional diseases :

1. **Kwashiorkor.** It is caused due to deficiency of protein in food. It is deficiency disease caused when babies take diet with carbohydrate inspite of mother milk.
2. **Marasmus.** It is caused due to deficiency of protein and carbohydrate.
3. **Hyponatremia.** It is caused due to deficiency of sodium in body.
4. *Hypokalamia. It is caused due to deficiency of potassium in body.*
5. **Scurvy.** Caused due to deficiency of vitamin C.
6. **Beri-beri.** Caused due to deficiency of vitamin B.
7. **Night blindness.** Caused due to deficiency of vitamin A.
8. **Pellagra.** Caused due to deficiency of niacin.
9. **Goitre.** Caused due to deficiency of iodine in body.
10. **Anaemia.** Due to iron deficiency.

Q. 6. Name some names of body parts whose failure to function properly gives rise to organic diseases. What are they ?

Ans. The improper functioning of the following body parts gives rise organic diseases :

	Body parts	*Organic Diseases*
1.	Heart	Cardiac failure
2.	Kidney	Kindney failure
3.	Bones	Oesteoporosis
4.	Eye lens	Myopia, cataract

Q. 7. What happens when there is an imbalance in the production of growth hormone in the body ?

Ans. Both hormones and nervous system co-ordinate body parts and biochemical reactions occurring in them. Hormones control and regulate many of our body functions. When there is an imbalance in the production of growth hormone, the imbalance occurs in our body functions. For example, Diabetes is caused due to deficiency of insulin hormone produced in pancreas. It controls level of the blood sugar (glucose) in blood.

Q. 8. Name some diseases caused by

(*a*) bacteria (*b*) fungi; and (*c*) protozoa.

How is malaria transmitted ?

Ans. (*a*) Bacterial disease. Pneumonia, tetanus, tuberculosis, leprosy, cholera, typhoid, syphilis, gonorrhoea.

(*b*) **Fungal disease.** Skin diseases (e.g. ringworm) food poisoning.

(*c*) **Protozoan disease.** Malaria, Amoebic dysentry and giardiasis.

Transmition of Malaria. The protozoan responsible malaria is plasmodium vivax transmitted by female mosquitoes.

Q. 9. What is polluted air ? Is tobacco smoke good for health ?

Ans. Air becomes polluted due to the presence of air pollutants viz. H_2S, SO_2, CO_2, NH_3, HCN, HF, HCl, Cl_2, carbonyl chloride, nitrogen oxide fluoride, lead, smoke and fumes from chimneys etc.

Tobacco smoking is not good for health

It is harmful in the following way :

1. It increases blood pressure.
2. It causes lung cancer, oral cancer and heart attack.
3. It causes lung diseases and bronchitis.
4. It causes cough and irritation in mouth.

Q. 10. How does alcohol affects nerves ? Why is narcotic drug habit dangerous ?

Ans. Alcohol affects neuromuscular control and judgement. It affects co-ordination and judgement. Alcoholic become unconciousness.

The narcotic drugs are highly addictive and habit dangerous. It is very strong habit than tabacco and alcohol. The addict needs narcotic drug regularly to satisfy the eraving. If we stop narcotic drugs, withdrawal symptoms develop such as violent illness and mental up set. So it is strong habit.

Q. 11. Give examples of two incidents of large scale pollution.

Ans. The accidental leakage of the deadly methyl isocyanate gas in the Union Carbide plant at Bhopal in Dec. 1984 was perhaps the most devastating incident of highly toxic chemical pollution of the world. It caused deaths of nearly 30,000 people and animals living in the neighbourhood and grievous injury to the health of much higher number.

The world witnessed the targedy when deadly radiation were let loose on innocent inhabitants of Hiroshima during the second world war by the dropping of atomic bomb. Thousand people died instantaneously. The survivors later developed metabolic and genetic disorders to few generations.

Q. 12. How does education help in keeping good health ?

Ans. Through education we come across so many informative agencies and we develop and attitude of awareness towards our day-to-day life. Proper education equips us with desired information and takes precautions before the situation goes out of hand.

Knowledge of food, digestive events and working of various bodyparts, quality and quantity of food, medical awareness, diseases and their prevention through treatment and cure and awareness of hygiene are some very essential factors we can learn through the proper education.

Q. 13. How can children's diseases be prevented by educating the parents ?

Ans. The children's diseases can be prevented by educating the parents in the following way :

1. The parents should be educated about good nutrition and balanced diet.

2. The parents should be aware for infections diseases and their causes. They can adopt preventive measures for these children's diseases.

3. We should give knowledge to the parents for personal and community health.

4. Mother care is a major factor to maintain children's health. Breast feeding is essential for children.

5. We should give a general idea to the parents that prevention is better than cure.

Q. 14. Can one dirty the drinking source ? State some methods by which water gets polluted.

Ans. One can dirty the drinking source. There are some methods by which water gets polluted :

1. Sewerage. Domestic waste and faeces etc. are thrown away into the river water and the whole water becomes polluted. Defaeting in the open is a major source of contamination.

2. Industrial waste. Industries or factories dump their chemical waste in restricted water source or river or on cultivated land.

3. Wastes of nuclear reactor pollute the water source.

4. Chemical fertilizers, insecticides, pesticides, herbicides and weedicides, DDT and chlorinated hydrocarbons pollute the water. These get concentrated in food chain and affect the consumers.

Fig. Contamination of water.

5. The detergents and soaps used to remove dirty pollute water source.

6. The oil layer on water surface pollute water source.

Q. 14. Why does dehydration set in during diarrhoea ? What can be done to prevent it ?

Ans. This disorder get caused by taking up contiminated food and water. During that diseases vomiting, loose motions, nausea and pain in abdomen takes place. By frequent vomiting and loose motions loss of water and minerals from the body takes place which may prove fatal if proper care is not taken. To fulfil the deficiency of water and minerals, glucose salt water is given to the patient frequently some proper medical treatment is given to avoid any mishappening.

Q. 15. Fill in the blanks :

1. Health is a state of _____ well being.
2. Staying healthy depends on the person and his _____.
3. Community health and _____ and both important.
4. A disease caused by the body reaction to some foreign material is called _____.
5. Infectious diseases are caused by _____ .

6. Cholera is caused by _____ but malaria is caused by _____.

7. A disease caused by important functioning of the organs of the body is known as _____ diseases.

8. The resistance of the body to specific disease causing organisms called _____.

9. Most diseases that effect children can be prevented by _____.

10. Heroin is a _____ drug.

Ans. (*i*) Physical, Mental and Social.

(*ii*) Environmental conditions.

(*iii*) Personal health.

(*iv*) Allergy.

(*v*) Micro-organism.

(*vi*) Bacteria, Protozoan.

(*vii*) Metabolic diseases.

(*viii*) Immunity

(*ix*) Regulated food.

(*x*) Narcotic drugs.

Q. 16. Match the casuative organisms and the factors with the diseases given in the first column.

Beri-beri	**Fungi**
Cataract	**Protozoa**
Amoebiasis	**Vitamin deficiency**
AIDS	**Eye lens defect**
Ring-worm	**Virus**
Leukemia	**Stress**
Hypertension	**Radiation**
Ans. Beri-beri	Vitamin deficiency
Cataract	Eye lens defect
Amoebiasis	Protozoa
Aids	Virus
Ring worm	Fungi
Leukemia	Radiation
Hypertension	Stress

Q. 17. State giving reasons which of the following statements are correct or not.

(*i*) Health is only the absence of physical disease.

(*ii*) Staying clean is not needed for good health as long as you eat a balanced diet.

(*iii*) Children need not be immunised.

(*iv*) AIDS cannot by sharing needles.

(*v*) Infant mortality rate is not an indicator of the state of development of a country.

Ans. (*i*) Health is only the absence of physical diseases is false. Because health is a state of well being. If you imagine the various situations that make you feel depressed and miserable you will begin to understand the conditions necessary for a healthy life.

(*ii*) Staying clean is not needed for good health as long as you eat a balanced diet. This statement is false. To keep body healthy it is essential that a person should clean himself along with balanced diet. Otherwise he may be suffered by some infectious diseases.

(*iii*) Children need not be immunised it is false. Children need immunisation against specific diseases with a gap of period to a healthy life.

(*iv*) AIDS cannot by sharing needles. It is not true. Because acquired immuno-deficiency syndrome is caused by a virus. This disease is usually contractial through sexual contact with an infected person.

(*v*) Infant mortality rate is not an indicator of the state of development of a country. This statement is wrong because the development of a country can be gauged by various factors. One of the direct indicators is the mortality rate of children.

Q. 18. Explain the following :

(*a*) Sickle cell anemia (*b*) Infection by house fly (*c*) Allergy (*d*) AIDS (*e*) Radiation effects (*f*) Ill effects of Tobacco.

Ans. (*a*) Sickel cell anemia. The action of lethal gene can be illustrated with sickle cell anemia. It is an inherited disease which is usually found in Negros. In such cases a change in shape of red blood cells occurs in the venous blood. Being deficient in O_2 tension these erythrocytes show a marked change in their normal structure attaining a sickle shaped structure. As a result rupturing of cell may take place and chronic hemolytic anemia is caused. Sickle cell anemia is caused when gene responsible for haemoglobin produced by recessive allele differs in one amino acid i.e. it incorporates valine in place of glutamic acid.

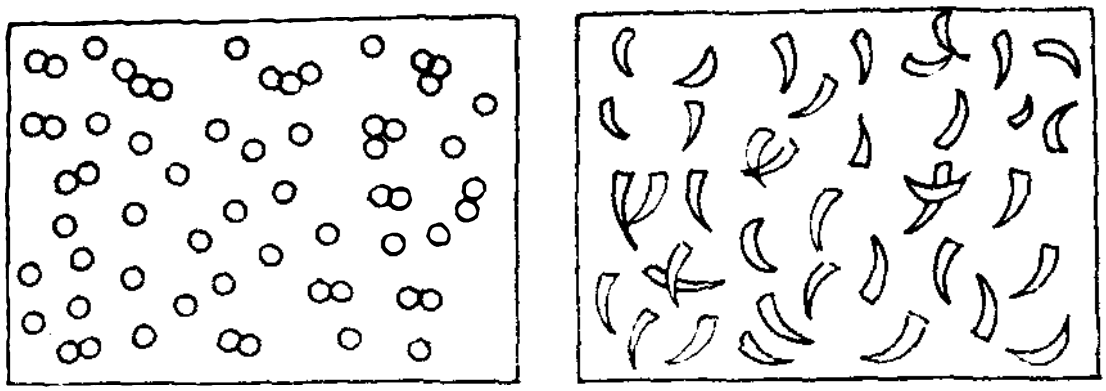


Fig. (A) Normal human red blood cells.
(B) Sickle-shaped red blood cellls of a diseased person.

(*b*) **Infection by House fly.** House fly (Muscadomestica) generally breeds on garbage, disposal sewage, polluted water and rubbish lying on the road side.

House fly is a vector of certain diseases cholera causing bacteria generates on dirty piece which is carried by house fly along with its legs and wings when fly on the food, contaminates the food. This food (contimunated food) now is responsible to cause cholera.

(*c*) ***Allergy.*** *It is the response of the body* to any substance or agent. These substances cause irritation in the body and are called as allergens. Persons may become allergic to various foods, drugs, dusts, pollengrains, fabrics, plants, bacteria, cold, heat, sunlight etc. In fact, any person can become allergic to anything and at any time during his life. Allergy, of any kind, may cause a wide variety of symptoms. In most of the cases, the skin becomes red, followed by eczema. Nose, eyes, throat etc. may also be effected. However these symptoms differ from person to person.

(*d*) ***AIDS.*** *Acquired immuno deficiency* syndrome (AIDS) a very recent disease, is believed to have originated in the African green monkey and has now spread to human beings.

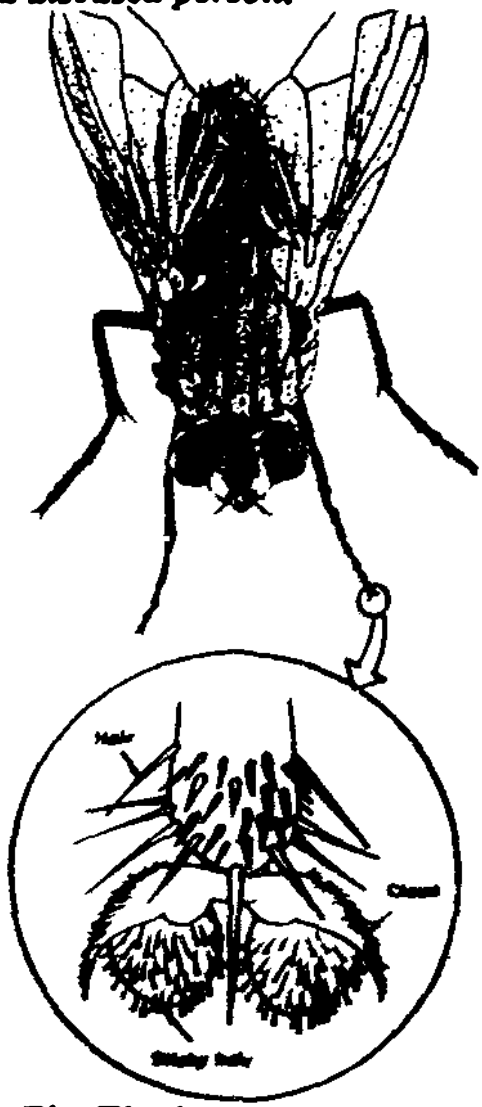


Fig. The housefly is a carrier of many germs.

This disease is transmitted from a diseased person to a healthy person through (*i*) simple physical contact; (*ii*) sexual contacts; (*iii*) blood transfusion; (*iv*) contaminated injection needles etc.

The disease is caused by a virus which in the host body attacks white blood corpuscles that are responsible for immune reactions of the body. AIDS virus causes severe damage to the brain and may lead to loss of memory, ability to speak and even think. No vaccine has so far been developed for AIDS.

(*e*) **Radiation effects.** Ionising : Radiation, X-rays, γ-rays, -particles. Non-ionising: radiation. U.V. Rays.

Ionising radiations split macro molecules of the cells by the process of ionisation. Exposing cells to ionising radiations may damage chromosomes, cause mutation or can mutilate the form of the organisms. Mutation, if occurs, brings deformities in the future generations. Alpha particles are charged and heavy, they lose their energy easily and cannot penetrate the skin. Beta particles are charged but very light and penetrate the skin. Gamma rays and X-rays are uncharged photons, similar to other electromagnetic waves, but are energetic and can penetrate even thick bodies. Absorption of radiations in living tissues lead to biologial damage.

Effects of non-ionising radiation (UV-rays)

1. UV-rays have shown to destroy epithelial tissue in plants and animals.
2. They create mutation.
3. They effect cell growth.
4. They interfere with genetic and metabolic activities.

(*f*) **Tobacco** : The ill effects of tobacco are the following :

1. It temporarily increases blood pressure.
2. It causes lung cancer and heart attack.
3. It causes cough and irritation in mouth and oral cancer.
4. The nicotine present in tobacco is injurious to health. Nicotine is stimulant and poisonous.
5. It leads to accumulation of tar in nose.

Q. 19. Why is ill health considered a medical, social and economic problem ? What roles do poverty and education play in keeping good health.

Ans. Almost everyone is interested in good health and the prevention of disease. Evidence of this fact is shown by the widespread growth of voluntary health agencies at the national, state and local levels. Voluntary health agencies

make important contributions to the public health resources of a community. National agencies are concerned with a single disease, which use their funds primarily for health education, professional educations research and in some instances medical care. All health is treated social, economic and medical problems for a person or community.

Health education. Health education was never more important than it is today when everyone needs the knowledge that enables one to take prompt advantage of the many protective health measures. The community health schemes should, therefore, be implemented in the schools because "A happy child is nation's pride". For the success of the project, help of doctors, social workers, psychologists and parents should be sought.

Nutrition education. Food is one of the fundamental aspects in improving health of people. Proper education is necessary to inform about the nature of food and the balanced diet, so that all essential components and nutrients get into the body for proper growth.

If a community is poor then they cannot spend proper money on their food to maintain environment clean and proper medical check up and medicine.

UNIVERSE

8.1. Universe. The universe includes everything that exists – the most distant stars, planets, satellites.

8.2. Galaxy. A huge bunch or a cluster of stars is called galaxy. There are about 10^9 galaxies in the universe and each galaxy contains about 10^{11} stars. The sun and the planets of the solar system belong to the galaxy, called the Milky Way (Akash Ganga). Our galaxy contains around a hundred thousand million (10^{11}) stars. The universe contains around three thousand million (3×10^{10}) galaxies, each galaxy contains about the same number of stars as our galaxy. The total of stars in our universe is about

$$10^{11} \times 3 \times 10^{10} = 3 \times 10^{21}$$

8.3. Light year. It is a unit of distance. It is equal to the distance travelled by light in one year. We know that light travels at a speed of 3×10^5 km/s and number of seconds in a year are $3600 \times 24 \times 365$. Hence the distance travelled by light in one year is $3 \times 10^5 \times 3600 \times 24 \times 365 = 9.46 \times 10^{12}$ km.

8.4. Parasec. It is still a bigger unit of distance. It is equal to 3.26 light years.

8.5. Two main categories of the galaxies

(1) **Normal galaxies.** A galaxy which can be observed by an optical telescope and can be photographed is called normal galaxy. Depending upon their shapes, the normal galaxies are divided in three groups.

(*i*) ***Irregular galaxies.*** These galaxies do not have any particular shape.

(*ii*) ***Spiral galaxies.*** Milky way and Andromeda are spiral galaxies.

(*iii*) *Elliptical galaxies.* They are most common type of galaxies and are the oldest in the universe.

(2) **Radio galaxies.** Galaxies which emit radiations predominantly are called radio galaxies.

8.6. Star. Stars are heavenly bodies that are extremely hot and have light of their own. There are millions of stars in the universe out of which about 5000 can be seen with the naked eye. The sun is the nearest star to the earth and have average size, mass and brightness. Many stars in the universe are far massive and brighter than sun.

8.7. Birth and evolution of star. The stars are formed from a cloud of dust and gases due to its own gravitational attraction. The particles of dust and gas present in the interstellar space come together due to gravitational force between them to form a cloud. These clouds mainly consist of hydrogen and have temperature of about – 173°C.

When the clouds of dust and gas grows to a large size, it starts contracting under the effect of its own gravitational force. As a result of compression, the cloud heats up and starts radiating the energy, which in turn helps the cloud to contract further and results in further heating up of the cloud. This process repeats again and again till the temperature of the central core becomes about 10^7 K.

At this temperature, the fusion of hydrogen atoms into helium atoms takes place with the release of energy in the form of light of different wavelengths. This energy keeps the star shining for million of years.

The increased pressure from within the star stops the gaseous matter from collapsing further inward. The star is now in delicate equilibrium under two opposing force – the gravitational attraction trying to compress and ignite the fusion reaction and the internal pressure exerted by the energy released by fusion. This balance can continue for thousand of million of years.

8.8. Age of Sun. The sun was created about 5000 million years ago. It is expected that the sun would become a red giant and die out as a *white dwarf* in another 5000 million years from now.

8.9. Source of energy due to which a star shines. It is fusion.

8.10. Stars do not collapse due to immense gravitational forces. The star is in equilibrium under two opposing forces: (i) the gravitational attraction trying to compress, (ii) the internal pressure generated by the energy released by fusion. This balance continues for thousands of millions of years, the temperature in the interior of the star just being enough to sustain the fusion reaction, and the rate of this reaction just right for balancing the pressure of compression.

8.11. Red giant Star. As fusion continues in the interior of the star, more and more hydrogen is converted into helium. After some time, therefore the matter in its core would consist mainly of helium. However, in the outer shell, it is mainly hydrogen which continues to fuse. When all the hydrogen in the core has been converted into helium, fusion in that region stops. When this happens the pressure inside the core drops and the core begins to contract again under gravitational force. The fusion reaction in the shell however continue and the shell beings to expand thereby increasing its surface area and reducing the intensity of radiated energy. The star now beings to change colour and becomes red. This phase in the star's life is called the red giant phase. The star is then called a red giant star.

8.12. Constellations. A group of stars arranged in a certain pattern is called as a constellation. If we see the sky on a clear night, some of the stars seem to be arranged in a certain beautiful patterns. These patterns are called as constellations. Each constellation has been given a name after familiar objects to which they seem to resemble. Some of the constellations are given below :

(1) *Orion* (Vyadha). It is a constellation in which the stars are arranged in a pattern which resembles orion (Vyadha). It consists of three stars that lie close to each other in a line. The brightest star in the sky Sirus lies close to this constellation. It is visible during the winter season.

(2) *Great Bear* (Saptarishi). It is also called as Ursa Major and resembles a large ladle (a cup with a large handle) or like a question mark. During spring and summer, it is above the horizon in the early part of the night. However, during autumn, it is easily visible.

(3) *Pleides* (Kruttika). It is a constellation which looks like a group of twinkling gems and is visible during winter.

(4) *Scorpio* (Vrishchika). As the name suggests, it resembles a scorpion with tail and pincers.

Some other constellations are :

(*a*) Draco (Dragon or Kabya)

(*b*) Auriga (Sarthi)

(*c*) Cygnus (Swan or Hans)

(*d*) Lyra (Svara-mandal)

8.13. White dwarf star. White dwarf star. (For those stars whose mass is equal to that of the sun). Such a star would lose its expending shell. The core left behind would gradually condense into an extremely dense ball of matter. The resulting high temperatures in its interior would then begin to

convert helium into higher elements, by fusion reactions. The energy liberated by the fusion of helium would make this small core glow as a white dwarf star; as long as it lasts before fading into a dense lump.

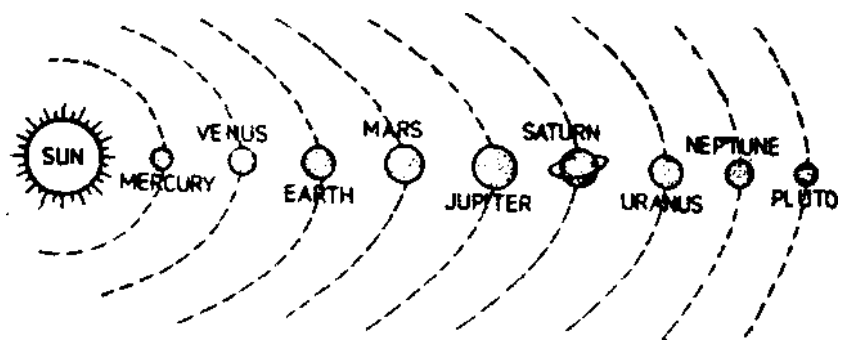
8.14. Black holes. The supernova explosion scatters the matter in the envelope into space. The heavy core continues contracting and becomes a neutron star. The fate of the neutron star depends again on its mass. It has been conjectured that heavy neutron stars could continue to contract indefinitely. This implies that the vast amount of matter in the neutron star would be packed eventually into a point! Such an infinitely dense object called a BLACK HOLE, would not let anything escape from it – not even light. Black holes are therefore invisible. However, their presence can be guessed from indirect evidence. For example, if we see a star moving in a circle with no other visible start in the centre, we would guess the presence of a black hole at the centre. One such possible location for a black hole is in the Cygnus Constellation.

8.15. Solar System. The part of the universe in which man lives is called solar system. The solar system is quite complicated and consists of the following :

(*i*) *The Sun.* It is called the centre of the solar system.

(*ii*) *Nine planets.* There are nine planets (including earth) revolving around the sun in elliptical orbits.

(*iii*) *Satellites of the planets.* Some of the planets have satellites (i.e. moons).



(*iv*) *Asteroids, Comets, Meteors, Meteorites, gas dust and small solids.* The solar system contains these constituents also.

Note. (i) The planet nearest to the sun is Mercury followed by Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.

(*ii*) Between the planets Mars and Jupiter there is a belt containing debris of varying sizes called asteroids.

8.16. Asteroids. Beyond Mars, we have a belt of tiny rock pieces revolving around the sun. These are called Asteroids. Asteroids revolve around the sun in a belt between Mars and Jupiter. The largest such piece is called Ceres with a radius of 350 km while the smallest is just 100 m in size. They are believed to be the pieces of a much large planet which broke up due to gravitational effect of Jupiter. The density and chemical composition of Asteroids is very much like that of moon.

8.17. Comets. Comets are large bodies constituted of a small rock like inner core surrounded by large masses of easily vaporised substances, like water, ammonia and methane. They travel in elliptical orbits around the sun with sun as its focus. As a comet approaches the sun, some of its outer substance is vaporised due to heat of the sun and pushed away in the form of a tail by the pressure of light from the sun. The head of a comet is of the order of 10,000 km and its size gradually decreases along the length until it then becomes like a tail. Comet is called a tailed star.

8.18. Meteors. Many comets break up into smaller pieces when they approach sun. These pieces fall towards the earth and burn due to friction of the atmosphere. The light so produced is visible from the earth. Such objects are called Meteors. These are called shooting stars. Meteors consist of small pieces of stones and metals. Most of the meteors are completely burnt in the atmosphere.

8.19. Meteorites. Sometimes the larger pieces of a comet are not able to burn completely. A small portion survives and actually reaches the earth surface. They appear stony or metallic. They are called meteorites.

8.20. Estimation of the age of solar system. We know that the nuclei of certain unstable atoms spontaneously break up to form smaller, more stable nuclei. The atoms which break up are called parent atoms and the smaller atoms formed are called daughter atoms. This is called the phenomenon of radioactivity. The rate at which parent atoms disintegrate into daughter atoms is known to be constant, and can be determined by performing careful experiments. For example, it is known that roughly 1/3 rd of the atoms present in a mass of uranium decay into lead every 4.5 billion years. The amount of lead in a sample which initially had no lead in it, will therefore give an indication of the age of the sample.

Samples of rock from moon and other planets collected by space probes or from a meteor which strikes our earth from space are taken. The amount of lead in these samples is determined and hence we can estimate the time when it was created. Thus the age of the solar system can be estimated.

8.21. Creation of earth. A number of planetesimals accumulate together to form the earth. It contained mainly the compounds of silicon, iron and magnesium. However, more and more planetesimals went on colliding with the earth and got stuck to it. In this process, their kinetic energy was converted into heat. Moreover, some heat was produced in the process of disintegration of some radio-active elements (U, Th, K, etc.). This resulted in the melting of the earth after about 800 million years of its formation. However, the earth began to reorganize itself due to the effect of its own gravity. With the increase in the temperature of the earth, the iron began to melt and heavy drops of this molten iron began to fall to the centre of the earth. It displaced the lighter particles which melted upto the surface of the earth. Thus, the iron became the core of the earth.

The process of formation of layers of earth is called as differentiation. As a result of differentiation, the earth was organized into three layers.

Layers of the earth. The three layers of the earth are :

(*i*) The outer crust of the earth.

(*ii*) The middle mantle

(*iii*) The inner core of the earth.

(*i*) **The outer crust of the earth.** The outer layer of the earth, called outer crust, envelops the whole of the earth. Its thickness changes from place to place. For example, its thickness ranges from 35 to 60 km under continents whereas it is about 10 km thick under oceans. It is generally composed of light elements.

(*ii*) **The middle mantle.** It is the middle layer of the earth. This layer extends upto a depth of about 2900 km under the surface of the earth.

(*iii*) **The inner core of the earth.** The inner core of the earth starts about 2900 km under the surface of the earth. This layer contains mainly molten iron with some nickel and sulphur. The temperature is very high (about 4000°C) in this part of the earth. The pressure is also very high here. It is estimated that here the pressure is about 3.7 million times the atmospheric pressure.

8.22. Bigh Bang. It has been observed that the galaxies are not stationary but are receding from each other. Therefore, we can say that our universe is not stationary but expanding. It means that the universe must have been very small in the past. At some point in the past, some event must have happened when the universe started expanding. This event is called as Big Bang.

8.23.' Difference between Star and planets

(*i*) A star has its own light whereas the planet has no light of its own. It shines because of the light received from the nearby star.

(*ii*) Stars appear to be moving from east to west. On the other hand, the planets move round the sun from west to east.

(*iii*) Stars are bigger in size than planets.

(*iv*) A star does not change its relative position in the sky. The relative positions of planets keep on changing day by day.

8.24. Milky way. Milky way is a convex lens shaped disc with a thick centre and thinning outwards. The diameter of the disc is 10^5 light years. The thickness of the milky way varies from 5000 light years at the centre, 1000 light years at the position of the sun and 500 light years at the edges. The milky way contains about 150 billions of stars revolving about the galactic centre.

TEXT BOOK QUESTIONS

Q. 1. In which part of the sky and at what time of the year are the following constellations seen ?

Scorpio, Great Bear, the pole star and the Orion.

Ans. The positions of constellations in the sky always go on changing. It has been observed that they advance by about 30°C each month. However, their relative positions (positions with respect to each other) always remain the same.

Scorpio can be seen in the sky during October-November. Great Bear can be easily seen in the autumn

(September-October).

The pole star can be seen any time in the year. The Orion is visible during winter season.

(December-January).

Q. 2. What are the gases from which a star begins to be formed ?

Ans. Hydrogen, Helium, Oxygen, etc.

Q. 3. In what manner does the life of star come to an end ? Explain.

Ans. As the fusion reaction continues inside a star, the more and more hydrogen is converted into helium. Therefore, after some times the whole of the hydrogen is converted into helium inside the core of the star. However, in the outer shell (on the surface), hydrogen continues to fuse into helium. When all the hydorgen has been converted to helium inside the core, the fusion reaction stops there. Due to this, the pressure inside the core drops and the core starts contracting under its own gravity. However, the fusion reaction in the outer shell continues and the shell starts to expand which increases its surface area and the intensity of the radiated energy is reduced. The colour

of the star now becomes red and this phase of the star is called as 'red giant phase'. The red giant phase of our sun will come after about 5000 million years from now.

After the red giant phase of star, there are two possibilities. If the initial mass of the star is not much (say similar to that of our sun), it would lose its expanding outer shell. Only the core of the star is left behind. It would gradually condense into a very dense ball of matter. Due to high temperature, the helium nucleus would be converted into higher elements by the fusion reactions. Due to the fusion reaction, the energy would be liberated which would make this small core to glow. This is called as a 'white dwarf star'.

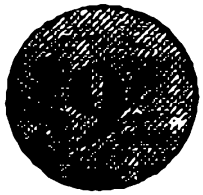
However, if the initial mass of the star is much higher, the core of the helium formed would go on contracting and thereby increasing its temperature more and more. After a certain limit, it would explode with a strong flash. This flash would be so strong that it will be seen in the sky for many days and would release so much energy in one second which our sun would liberate in hundred years. Such an exploding star is called as a 'Supernova'.

Q. 4. How are meteorites dated ?

Ans. Meteorites are dated by observing the phenomenon of radioactivity. When a meteor strikes the earth, the amount of the daughter elements in it gives us an idea about the age of that meteor.

Q. 5. What is the evidence for the hypothesis that the universe began in a big bang ?

Ans. It was observed by an astronomer, Edwin Hubble in the year 1920 that the galaxies were not stationary but were receding away from each other. Also, the speeds of the galaxies with which they receded from each other were proportional to the distance between them. More the distance between two galaxies, more will be the speed with which they recede from each other. This shows that our universe is expanding. The point of time when this process of expansion started is known as Big Bang. The recession of the galaxies from each other shows us the evidence for the hypothesis that the universe began in a big bang.



THE EARTH SYSTEM

9.1. Planets. The non-luminous bodies that orbit the sun are called planets e.g., the earth is one of the planets.

9.2. Differentiation. The earth heated up as it was being formed. When it eventually melted about 800 million years after its formation, its material was reorganized under the influence of gravity into layers of different density. This is called the process of differentiation. As a result of differentiation, three distinct layers were formed the outermost crust, the underlying mantle and the central core.

9.3. Earth is a unique planet. The earth is a unique planet in which oxygen is readily available and in sufficient quantity. Oxygen is essential for living organisms. Its atmospheric conditions are suitable to living organisms Its land and seas support wonderful variety of living organisms.

9.4. Only earth is a planet where life is evolved. The earth is situated at just the right distance from the sun and possessing just the right mass, it became the only planet in the solar system on which life evolved. Scientists worked out that the basic life support zone exists in a region of space about 65 million kilometres on either side of the orbit of the earth.

9.5. Life can exist without oxygen present in atmosphere. Yes, life can exist without oxygen. The first organism appeared on the earth was blue green algae which could trap sunlight to convert CO_2 of seawater into carbon molecules for food and oxygen. At that time, there was mainly hydrogen, carbon dioxide and nitrogen in the atmosphere. Oxygen was like a poison to early organisms because they were extremely sensitive to oxidation.

9.6. Igneous rocks formed. The region of the earth under the lithosphere is the mantle. The upper region of the mantle is made up of molten rocks and gases called **magma.** In this region, vast slow convection currents of magma circulates. The hot magma being lighter floats up while cool heavy magma

sinks towards the centre. Magma can emerge out through the vents on the surface of the earth and solidify as igneous rock. The west central part of India - the Deccan Plateau is fashioned in this way.

9.7. Occurrence of volcanic erruption. Sometimes a vent is plugged which prevents the lava from emerging. As the gases build up at this point, they begin to exert tremendous pressures until a point, the plug gives way. The magma now explodes through the vent as a volcanic eruption. Volcanoes are, therefore, found near vents where two plates are joined to one another.

9.8. Formation of mountains. The convection currents of magma in the mantle can cause plates of the lithosphere to glide scrape and push each other building mountains in this process.

9.9. Occurrence of earthquake. Sometimes, when the rock at the joint is sufficient slippery, the convection current just causes the plates to slide gently past one another. In some cases, the rocks at the joint interlock into one another resisting pressure from within. As these pressures build up, sometimes over hundred of years, the intolerable strain can rip the two plates apart. This is how an earthquake occurs. The tremendous release of energy sends shock waves, through the lithosphere sometimes flattening entire cities.

9.10. Recycling of lithosphere. As the plates crash into one another raising mountains, causing earthquakes and volcanic eruptions, a part of the lithosphere goes into the magma below. The material of the lithosphere is added to magma, emerges from vents elsewhere and solidifies. Thus, this material is again regenerated into the lithosphere. We see that the lithosphere is constantly recycled by the processes within the earth.

9.11. Importance of lithosphere. Lithosphere is a large reservoir of resources useful to man. The minerals of the lithosphere provide the basic material from which he makes tools, instruments and commodities for his use. The lithosphere is also the repository of fuels, coal, oil and gas without which civilization, as we know it today, would have been impossible.

9.12. Formation of coal in the earth. Over 250 million years ago, large parts of the continents were covered by swamps. Dense fern forests grew in them consuming a lot of solar energy and carbon extracted from the atmosphere, into carbohydrate biomass, and liberating oxygen into the atmosphere. These extensive plant materials were turned into a valuable resources by a sequence of earth system processes. Just after these fern forests developed and thickened, the earth opened up chasms in which they were buried and put out of reach of oxygen. Successive layers of sediments buried these plant remains even more protectingly, which with age and pressure were converted into coal.

9.13. Stable constituent of atmosphere. Nitrogen (N_2), Oxygen (O_2), Argon (Ar), Carbon dioxide (CO_2), Neon (Ne), Helium (He), Methane (CH_4), Krypton (Kr), Hydrogen (H_2), Nitrous oxide (N_2O) and Xenon (Xe) are stable constituents of atmosphere.

9.14. Test for the presence of oxygen in atmosphere. Combustion is the reaction in which substance vigorously combines with oxygen and liberates heat. Combustion is, therefore, test for oxygen in atmosphere.

9.15. Test for the presence of carbon dioxide in atmosphere. Lime water turns milky if it is kept in atmosphere which shows the presence of carbon dioxide in atmosphere.

9.16. Test for the presence of water vapour in atmosphere. The water vapours get condensed on the surface of cold object. A glass of cold water will thus have droplets of this condensed water vapours on its sides.

9.17. Nature helps in cleaning many of the pollutants. Nature cleans many of the pollutants with rain. Green plants absorb most of the excess CO_2 from the atmosphere and give back healthy oxygen. Planting more trees can help us to control pollution.

9.18. Temperature of atmosphere is increasing. We have released approximately 36000 million tonnes of CO_2 and are continuing to do so at an increasing pace. As a result of large scale dumping, the proportion of CO_2 has increased by 13%. This would have increased the average temperature of the earth by 1°F due to Green house effect.

At the end of this century the earth's average temperature would have increased by about 3.6°F.

9.19. Important constituents of sea water. Sea water is a mixture of various salts. The salts of sodium, magnesium, calcium and potassium are present in sea-water. Various salts in the ocean can precipitate and settle down on the ocean floor as sediment. The various processes like weathering and eroding of rocks add salts to the oceans balance the salts lost due to sedimentation. This maintains the level of salt in the sea at fairly constant value.

9.20. Afforestation. The replanting of destroyed trees and forests is called afforestation.

9.21. Weathering of rocks. It is a process of transformation of rock in hostile surface environment and involves complex process that change the internal structure of minerals.

9.22. Important functions of the oceans. They regulate the temperate of our globe. As the wind blows over the surface of water, it draws the water along. The rotation of the earth also causes the water to flow along a particular

path. These ordered flows are called ocean currents. The temperature difference between different points causes water to flow. These flows carry heat from the lower to the higher latitudes, regulating the temperature.

The oceans are a reservoir of resources. The ocean beds contain fossil fuel which can be mined. Metals like manganese, cobalt and nickel precipitate out of sea-water and settle on the ocean bed in the form of nodules. These 'manganese nodules' are an important resource.

TEXT-BOOK QUESTIONS

Q. 1. Describe the evolution of the atmosphere.

Ans. The atmosphere is the sea of air which surrounds the earth. It has no distinct boundary. It is believed that our present atmosphere is largely of secondary origin having been formed by degassing of the solid body of earth. As the gravitational contraction and radioactive decay resulted in that generation, gases were released from their compounds. These were retained as atmosphere around the earth due to sufficient gravity. The two lightest gases, hydrogen and helium escaped the gravitational effect and hence are almost not present in the atmosphere.

It is safe to assume that volatile matter now at the surface of earth has come from the interior. It is still receiving additions from present day volcanic activity.

The composition of the earth's atmosphere differs from day to day, from altitude to altitude and from place to place. The concentration of vapour varies to the largest extent.

There is low concentration of hydrogen and helium in the air. The earth is rather small object and exerts a relatively low gravitational attraction on the gases above it. Therefore, most of the hydrogen and helium originally associated with the matter of the earth could be lost rather easily. Nitrogen is more abundant than oxygen in the air.

Q. 2. What evidence would you give for the absence of oxygen in the early atmosphere ?

Ans. In the early atmosphere there was mainly hydrogen, carbon dioxide and nitrogen.

Early organisms were extremely prone to oxidation. An atmosphere progressively enriched with oxygen by the waste product of photosynthesis alone would have oxidised and killed them before they had a chance to invent newer organisms with a higher chance of survival in a changing environment. By a most fortunate circumstance, however, the new oxygen exhaled by the

organisms was siphoned off by the iron dissolved in the oceans. We know this from the extensive deposits of bonded iron stones that were formed between 3.5 and 2.0 billion years ago.

Q. 3. How were the oceans formed ?

Ans. Since matter contracts on cooling, the inner parts of the earth on getting comparatively cooled caused loosening of the solidified crust. This resulted in the formation of ups and downs on the surface. The ups are called mountains. As soon as the temperature of the crust became below the boiling point of water there was heavy rain which filled all the depressions on the surface of the earth.

That is how oceans were created.

Q. 4. What are the main pollutants and their origin ?

Ans. The pollutants and their origin are given below :

(*i*) Burning of fuels like coal, wood and oil produces smoke which pollutes air. Smoke contains poisonous gases like carbon monoxide and sulphur dioxide.

(*ii*) Exhaust gases emitted by internal combustion engines of cars, buses, trucks, aeroplanes etc. pollute air. Car exhausts contain poisonous gases like carbon monoxide, nitrogen oxides, some lead compounds and unburnt carbon particles which pollute air.

(*iii*) Chemical industries pollute air. The chemical industries discharge various poisonous gases into the air which pollute air. Industries engaged in the extraction of metals produce sulphur dioxide. This sulphur dioxide goes into the air and causes pollution.

(*iv*) Smoking pollutes air. Smoking produces carbon monoxide and nicotine which are poisonous chemicals and pollute air.

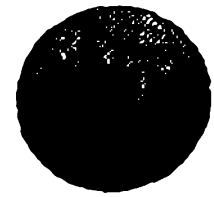
(*v*) *Dust pollutes air. Dust produced by the heavy traffic and various* industrial operations pollutes air.

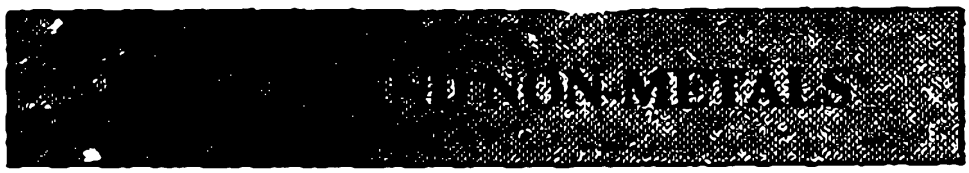
Q. 5. Describe the green house effect.

Ans. The water vapours and carbon dioxide are the main absorbers of the radiation rays. A clear and dry sky shows a larger difference between the night and day temperature than a dusty and humid sky. In a green house, the temperature inside the glass walls is much higher than on the outer sides which are exposed to the radiation rays directly. The glass walls of the green house permit the radiation rays of shorter wavelength to enter inside but these walls do not allow the exit of radiation rays of longer wavelength from the inside of glass walls. This specific behaviour of the glass walls increase the temperature of green house on its inner surface in comparison to its outer surfaces.

Q. 6. *What is the importance of the ozone layer ?*

Ans. Ozone layer does not allow the harmful ultraviolet rays of sunlight to pass through it. Therefore, it is due to the ozone layer in the atmosphere that the harmful ultraviolet radiations coming from the sun do not reach us on the earth and we are saved from their bad effects. The ultraviolet radiations destroy the organic molecules necessary for life.





10.1. Metals. We have about eighty metals. Metals have 1 to 3 electrons in the outermost shell of their atoms whereas non-metals have usually 4 to 8 electrons in the outermost shells of their atoms. A metal is an element (except hydrogen) which forms positive ions by losing electrons. Since metals have 1 to 3 electrons in the outermost shells of their atoms, they can lose these electrons to achieve the stable inert gas electron arrangement.

A non-metal is an element which forms negative ions by gaining electrons. Since non-metals have 4 to 8 electrons in the outermost shell of their atoms, they accept electrons to achieve the nearest inert gas configuration.

10.2. Characteristic Properties of Metals.

Physical Properties

(*i*) *Malleability.* Metals are malleable. That is, metals can be hammered into very thin sheets. Gold and silver are among the best malleable metals. These can be hammered into foils.

(*ii*) *Ductility.* Metals are ductile. That is, metals can be drawn into thin wires. All metals are not equally ductile. We can draw a wire of about 200 metres from 100 mg of silver.

(*iii*) *Thermal and electrical conductivity.* All metals are conductors of heat. Silver is the best conductor of heat. The poorest conduction among the metals is lead (Pb).

Metals are good conductors of electricity. The best conductors of electrical current are silver and copper. They are followed by gold, aluminium and tungsten

(*iv*) *Super conductivity.* The electrical conductivity of many metals drops suddenly to zero when they are called to a sufficiently low temperature, often a temperature in the liquid helium range. This phenomenon was first observed by K. Onnes in 1911 in mercury. The resistivity of mercury vanished completely below 4.2 K. This loss of electrical resistance by metals known as super conductivity and such metals are called super conductors.

Chemical Properties

(*i*) *Reaction with oxygen.* All metals combine with oxygen and form metal oxides. The atoms of the metal give away loosely bound electrons forming positive metal ions. The atoms of oxygen on the other hand receive electrons forming negative oxide ions.

$$Mg \rightarrow Mg^{2+} + 2e^-$$

$$O + 2e^- \rightarrow O^{2-}$$

$$Mg + O \rightarrow MgO$$

Metal oxides are basic in nature. Some of them dissolve in water forming alkalies.

$$Na_2O + H_2O \rightarrow 2NaOH$$

Some metals such as sodium and potassium react with oxygen vigorously. They catch fire even if kept open in the air. Magnesium needs to be heated before it combines with oxygen to produce heat and light. Zinc metal burns in air only on strong heating to form zinc oxide. Iron metal does not burn in air even on strong heating. Iron reacts with the oxygen of air on heating to form iron (II, III) oxide. Reaction of oxygen with copper is slow. A lot of heat is to be provided to carry out this reaction.

$$4Na + O_2 \rightarrow 2Na_2O$$
Sodium oxide

$$2Mg + O_2 \rightarrow 2MgO$$
Magnesium oxide

$$2Zn + O_2 \rightarrow 2ZnO$$
Zinc oxide

$$2Fe + 2O_2 \rightarrow Fe_3O_4$$
(Iron II, III oxides)

$$2Cu + O_2 \rightarrow 2CuO$$
(Copper II oxide)

Order of reactivity of these metals with oxygen is :

Na > Mg > Zn > Fe > Cu

Most reactive — Least reactive

(*ii*) **Reaction of metals with dilute acids.** When a metal reacts with a dilute acid, a metal salt and hydrogen are formed. Metals react with dilute hydrochloric acid to give metal chlorides and hydrogen. Metals react with dilute sulphuric acid to give metal sulphates and hydrogen.

(*a*) Sodium metal reacts violently with dil. hydrochloric acid to form sodium chloride and hydrogen.

$$2Na + 2HCl \rightarrow 2NaCl + H_2$$

(*b*) Magnesium reacts rapidly with dilute hydrochloric acid forming magnesium chloride and hydrogen gas.

$$Mg + 2\,HCl \rightarrow MgCl_2 + H_2$$

The reaction of magnesium with dilute HCl is less vigorous than that of sodium, therefore magnesium is less reactive than sodium.

(*c*) Zinc reacts with dilute hydrochloric acid to give zinc chloride and hydrogen gas but the reaction is less rapid than that of magnesium. Therefore, zinc is less reactive than magnesium.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

(*d*) Iron reacts with cold dilute hydrochloric acid to give iron (II) chloride and hydrogen. Iron is less reactive than zinc.

$$Fe + 2HCl \rightarrow FeCl_2 + H_2$$

(e) Copper does not react with dil. HCl at all. Therefore copper is least reactive. Therefore, the order of reactivity of these metals with dilute acids is

$$\underset{\text{Most reactive}}{Na} > Mg > Zn > Fe > \underset{\text{Least reactive}}{Cu}$$

(*iii*) **Reaction with chlorine.** Metals form electrovalent chlorides where metal looses electrons and becomes positively charged ion and chlorine becomes negatively charged ions by gaining electrons.

$$2Na + Cl \rightarrow 2NaCl$$

$$Mg + Cl \rightarrow MgCl_2$$

$$2Fe + 3\,Cl_2 \rightarrow 2FeCl_3$$

$$Cu + Cl_2 \rightarrow CuCl_2$$

(*iv*) **Reaction with hydrogen.** A few reactive metals like K, Na, Ca form hydrides with hydrogen.

$$2Na + H_2 \rightarrow 2NaH$$

$$Ca + H_2 \rightarrow CaH_2$$

10.3. Reactivity Series of Metals

K	(Potassium)	(Most reactive metal)
Ba	(Barium)	
Ca	(Calcium)	

Na	(Sodium)	
Mg	(Magnesium)	
Al	(Aluminium)	
Zn	(Zinc)	
Fe	(Iron)	
Ni	(Nickel)	
Sn	(Tin)	
Pb	(Lead)	
H	(Hydrogen)	
Cu	(Copper)	
Hg	(Mercury)	
Ag	(Silver)	
Au	(Gold)	(Least reactive metal)

10.4. Occurrence of metals. Metals occur in nature, sometimes free but mostly in combined state. The majority of metals are found in the form of metal bearing substances called minerals. The minerals from which metals can be extracted profitably called ores. Gold, silver, copper, platinum and bismuth are found in the free state because of their low reactivity.

Aluminium is the most abundant metal in the earth's crust. It is followed by iron, calcium, sodium, potassium, magnesium and titanium. All other metals are present to a much smaller extent.

10.5. Ores of some common metals.

Metal	*Name of Ores*	*Chemical Composition*
1. Sodium	(*a*) Rock salt	$NaCl$
	(*b*) Chile Saltpetre or caliche	$NaNO_3$
	(*c*) Borax	$Na_2B_4O_7 \cdot 10H_2O$
2. Potassium	(*a*) Carnallite	$KCl \cdot MgCl_2 \cdot 6H_2O$
	(*b*) Indian saltpetre	KNO_3
3. Magnesium	(*a*) Magnesite	$MgCO_3$
	(*b*) Dolomite	$MgCO_3 \cdot CaCO_3$
	(*c*) Carnallite	$KCl \cdot MgCl_2\ 6H_2O$
	(*d*) Epsomite	$MgSO_4 \cdot 7H_2O$
4. Calcium	(*a*) Lime stone, marble, chalk	$CaCO_3$
	(*b*) Dolomite	$CaCO_3\ MgCO_3$
	(*c*) Calcite	$CaCO_3$
	(*d*) Gypsum	$CaSO_4 \cdot 2H_2O$

Metal	*Name of Ores*	*Chemical Composition*
5. Copper	(*a*) Copper glance or chalcosite	Cu_2S
	(*b*) Copper pyrites	$CuFeS_2$
	(*c*) Cuprite	Cu_2O
	(*d*) Malachite	$CuCO_3 \cdot Cu(OH)_2$
	(*e*) Azurite	$2CuCO_3 Cu(OH)_2$
	(*f*) Indigo copper	CuS
6. Silver	(*a*) Horn silver or chlorargyrite	$AgCl$
	(*b*) Argentite or silver glance	Ag_2S
	(*c*) Ruby silver or pyrargyrite	Ag_3SbS_3
7. Zinc	(*a*) Zinc blende	ZnS
	(*b*) Calamine	$ZnCO_3$
	(*c*) Zincite	ZnO
	(*d*) Hemimorphite	$[Zn_4Si_2O_7(OH)_2 \cdot H_2O]$
8. Mercury	Cinnabar	HgS
9. Aluminium	(*a*) Bauxite	$Al_2O_3 \cdot 2H_2O$
	(*b*) Cryolite	Na_3AlF_6
	(*c*) Corrundum	Al_2O_3
10. Tin	Tin stone or cassiterite	SnO_2
11. Lead	Galena	PbS
12. Antimony	Stibnite	Sb_2S_3
13. Bismuth	(*a*) Bismuth glance	Bi_2S_3
	(*b*) Bismite	Bi_2O_3
	(*c*) Bismuthite	$(BiO_2)CO_3$
14. Chromium	(*a*) Chromite	$FeO \cdot Cr_2O_3$
	(*b*) Chrome ochre	Cr_2O_3
	(*c*) Crocoisite	$PbCrO_4$

10.6. Metallurgy. Extraction of metals from their ores and refining them for use is called metallurgy. Metallurgical processes consist of three steps :

(1) Preliminary Treatment

Concentration of the ore. Ores mined from earth usually contain unwanted material called gangue. The gangue needs to be removed prior to the extraction process. Removal of gangue may be based on the differences between physical or chemical properties of ore and the gangue.

Conversion of concentrated ore into metal oxide : Calcination is the process in which an ore is heated strongly in the absence of air :

(*i*) to convert a carbonate ore into metal oxide,

(*ii*) to expel water from hydrated ores and

(*iii*) to expel volatile impurities from the ore.

$$ZnCO_3 \xrightarrow{\text{Calcination}} ZnO + CO_2\,(g)$$

Roasting is the process in which an ore is strongly heated in the presence of air to convert the sulphide ore into metal oxide and to remove volatile impurities.

$$2\,ZnS + 3\,O_2 \xrightarrow{\text{Roasting}} 2\,ZnO + 2\,SO_2\,(g)$$

(*ii*) **Reduction.** Reduction is the process of obtaining metals from their compounds. There are three main ways of reducing metals. Metals low in the reactivity series can be obtained by heating their compounds. For example, mercury is produced by roasting the ore cinnabar (HgS) in air.

$$HgS + O_2 \rightarrow Hg + SO_2$$

Metals in the middle of the reactivity series, e.g. Iron, zinc, nickel, tin, etc., cannot be produced by heat alone. They are to be heated with a reducing agent which is usually carbon. When metal oxide is heated with carbon, the metal is freed from oxygen.

$$MO + C \rightarrow M + CO_2$$

where M is a metal.

Highly reactive metals like sodium, calcium, aluminium can also be used as reducing agents. For example, manganese dioxide is reduced to manganese by aluminium.

$$3MnO_2 + 4Al \rightarrow 3Mn + 2Al_2O_3$$

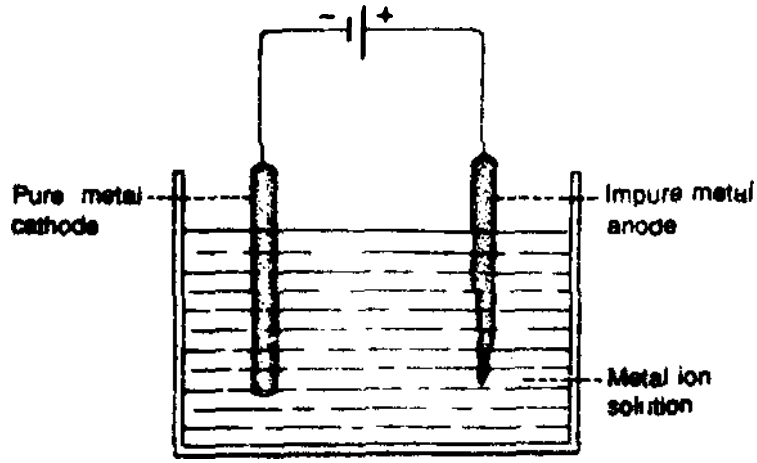
Such reactions are highly exothermic producing metals in molten state and can be used for welding metals.

The reactive metals (that is the metals high up in the reactivity series) cannot be produced either by heating or by carbon reduction. They are obtained by electrolytic reduction. Sodium and magnesium are obtained by electrolysis of the fused chloride. The chlorine gas is liberated at anode whereas metal is deposited at cathode.

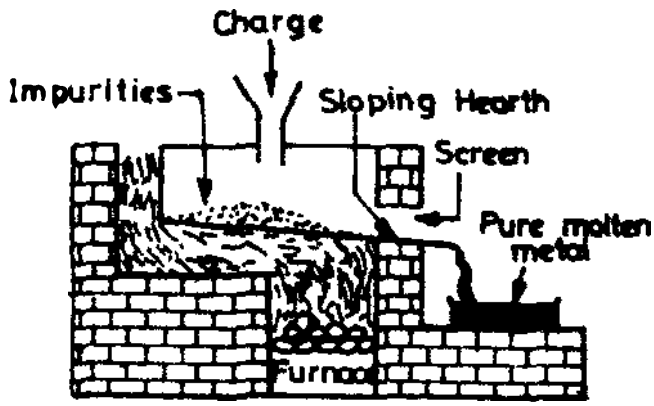
(*iii*) **Refining.** Refining is the purification of metals.

(*a*) *Electrolytic refining.* Many metals like copper, tin, lead, gold, zinc, chromium and nickel are refined electrolytically. In this process impure metal acts as anode, a strip of pure metal as cathode and a solution of melt salt as

an electrolyte. On passing the current through the electrolyte pure metal gets deposited on cathode. In case of copper, copper sulphate is used as the electrolyte and pure copper rod as cathode. The more reactive metals in the crude copper anode such as iron pass into solution and remain there. The less reactive metals such as gold and silver fall to the bottom of the electrolytic cell and are recovered in the native state.

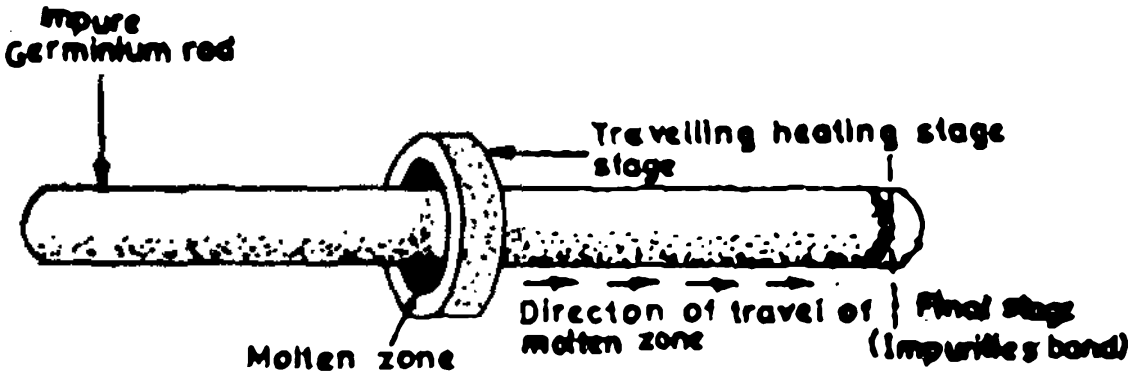


(*b*) *Liquation.* Crude tin, lead and bismuth are purified by the process known as liquation. In this process a sloping hearth is used. The hearth is maintained at the temperature slightly above the melting point of the metal and impure metal is placed at the top of the hearth. Metal melts and flows down whereas solid impurities remain behind.



(*iii*) **Van Arkel method.** Ultra pure metals are prepared by Van Arkel method. Metal is converted to a volatile stable compound. The compound so obtained is then decomposed to get the pure metal. This method is being used for the purification of metals like titanium and zirconium.

(*iv*) **Zone refining.** Metals of very high purity can be obtained by this method by removing an impurity which shows differences in solubility in the liquid and solid states of the metal. A circular heater is fitted around an impure germanium rod and slowly moved down the rod. Heater melts a band of the metal and as the heater moves along the metal crystallises out of the melt. The impurities are swept along in the molten zone and finally reach to the other end of the rod which is then discarded.



Ge, Si and Ga used as semi-conductors are refined in the manner.

10.7. Copper. The various ores of copper are

(*i*) Copper pyrite	$CuFeS_2$
(*ii*) Copper glance	Cu_2S
(*iii*) Cuprite	Cu_2O
(*iv*) Malachite	$Cu(OH)_2\,CuCO_3$
(*v*) Azurite	$Cu(OH)_2\,2CuCO_3$

10.8. Extraction of Copper from Copper Pyrite

(*i*) **Concentration.** The ore is concentrated by the froth-floatation process. The finely powdered ore is mixed with water and pine oil, in a large tank. The ore particles are preferentially wetted by the oil, whereas the gangue particles are wetted by water. Air is bubbled through the mixture. As a result of froth containing ore particles is formed which floats on the top of the water and can be skimmed off easily.

(*ii*) **Roasting.** The concentrated ore is roasted in air when a mixture of copper (I) sulphide and iron (II) sulphide is obtained.

$$2CuFeS_2 + O_2 \xrightarrow{\text{Roasting}} Cu_2S + 2FeS + SO_2$$

The roasted ore containing copper (I) sulphide and iron (II) sulphide is mixed with sand, a little coke and heated in a blast furnace.

Here, most of the iron (II) sulphide is oxidised to iron (II) oxide.

$$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$$

This iron (II) oxide reacts with sand to form iron (II) silicate (slag) which is removed.

$$FeO + SiO_2 \rightarrow FeSiO_3$$

Iron (II) silicate

Thus, most of the iron (II) sulphide is removed.

(iii) **Conversion to a metal.** The molten mixture of copper (I) sulphide and the remaining iron (II) sulphide called matte is put in Bessemer converter and a blast of hot air mixed with sand is blown in.

The remaining iron (II) sulphide is completely oxidised to copper (I) oxide. This copper (I) oxide reacts with the remaining copper (I) sulphide to form copper metal.

$$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$$

$$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$$

Copper thus formed is in molten state. Since sulphur dioxide gas passes through molten copper, blisters are developed on the surface of copper which is known as blister copper.

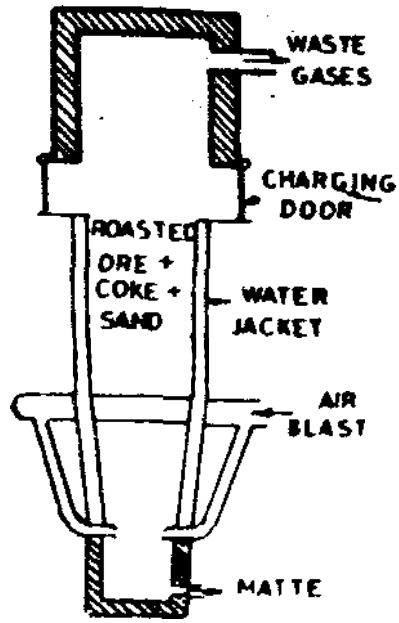


Fig. Blast furnace for copper

(iv) **Electrolytic refining of copper.** A thick plate of impure copper is made anode and a thin plate of pure copper is made cathode. Copper sulphate solution acidified with sulphuric acid is taken as electrolyte.

When electric current is passed through copper sulphate solution, impure copper from the anode goes into solution, and pure copper from the solution deposits on cathode.

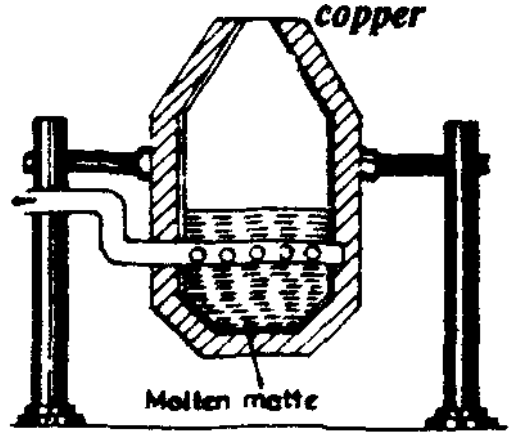


Fig. Bessemer converter of copper

At anode $Cu(s) \rightarrow Cu^{2+}(aq) + 2e$

At cathode $Cu^{2+}(aq) + 2e \rightarrow Cu(s)$

10.9. Uses of Copper

(i) It is used for making electric wires because it is highly ductile and best conductor of electricity.

(ii) It is used for making cooking utensils, boilers, kettles and calorimeter because it is highly malleable and good conductor of heat.

(*iii*) It is used for making coins, containers and water pipes for domestic use because it is not attacked by air or water.

(*iv*) It is used for forming alloys such as brass, bronze and German silver.

10.10. Iron. The main ores of iron are :

(*i*) Haematite, Fe_2O_3

(*ii*) Magnetite, Fe_3O_4

(*iii*) Limonite, $Fe_2O_3 \cdot 3H_2O$

(*iv*) Siderite, $FeCO_3$

10.11. Extraction of iron from haematite.

(*i*) **Dressing of the ore.** The ore is broken into small pieces about 2 cm in size and then washed with water to remove sand, clay etc.

(*ii*) **Calcination.** The washed ore is then heated in the absence of air to expel water sticking to it.

(*iii*) **Smelting.** The washed and dried ore is mixed with calculated quantities of coke and lime stone, and put into a blast furnace from the top. A blast of hot air is blown into the furnance from near its bottom.

10.12. Reactions in the blast furnace :

(*i*) Near the bottom of the furnace coke burns in air to form carbon dioxide, and a lot of heat is produced.

$$C + O_2 \rightarrow CO_2 + \text{Heat}$$

(*ii*) In the centre of the furnace, carbon dioxide reacts with hot coke to form carbon monoxide.

$$CO_2 + C \rightarrow 2CO$$

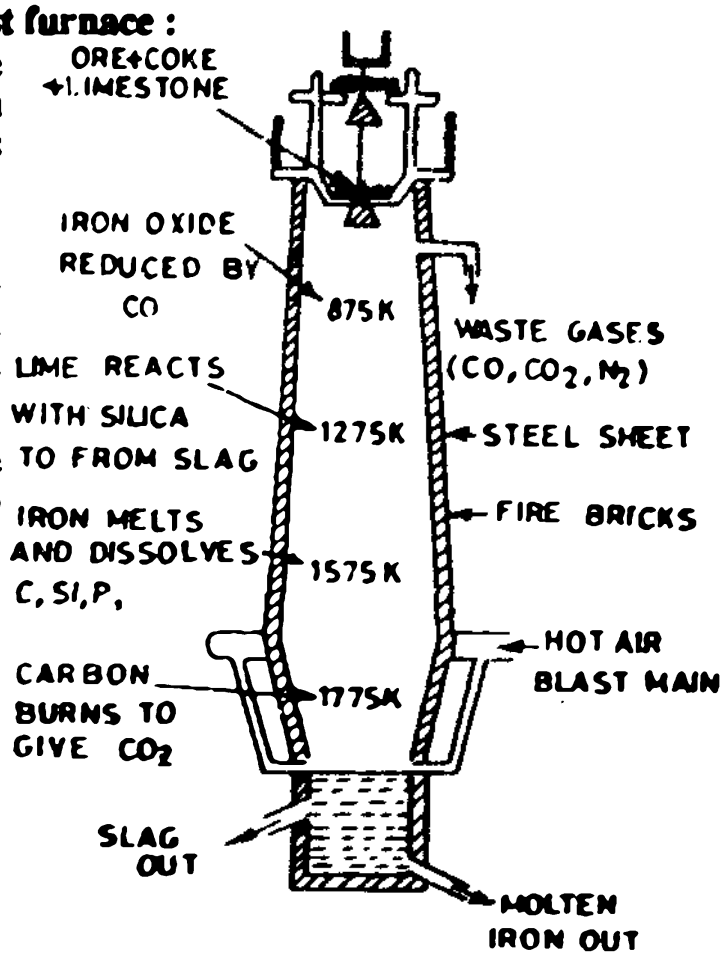
(*iii*) In the upper part of the furnace, CO reduces iron (III) oxide to iron.

$$Fe_2O_3 + CO \rightarrow 2Fe + 3CO_2$$

Lime stone gets dissociated because of intense heat in the furnace.

$$CaCO_3 \rightarrow CaO + CO_2$$

Calcium oxide reacts with silicon dioxide to form liquid calcium silicate.



$$CaO + SiO_2 \rightarrow Ca\ SiO_3$$

The molten slag, being lighter than iron floats on the surface of molten iron in the blast furnace and can be removed.

About 3000 – 6000 tons of iron are produced daily by a single blast furnace. Once started the blast furnace can continue upto five years. In India iron is extracted at Bhilai, Durgapur, Rourkela and Jamshedpur.

10.13. Aluminium. The important ores of aluminium are :

(*i*) Bauxite, $Al_2O_3 \cdot 2H_2O$

(*ii*) Cryolite, Na_3AlF_6

10.14. Extraction of aluminium from bauxite.

(*i*) **Purification of bauxite.** Bauxite usually contains oxides of iron, silicon, and titanium as impurities. The crude bauxite is finely powdered and heated with concentrated sodium hydroxide solution. The aluminium oxide present in bauxite dissolves in sodium hydroxide solution forming sodium aluminate.

$$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$$

The oxides of iron, silicon and titanium do not dissolve in sodium hydroxide solution, therefore they are removed by filtration.

Sodium aluminate solution is diluted with water and a little freshly prepared aluminium hydroxide is added to it for seeding. Sodium aluminate is hydrolysed to form aluminium hydorxide.

$$NaAlO_2 + 2H_2O \xrightarrow{\text{hydrolysis}} Al(OH)_3 + NaOH$$

The aluminium hydroxide precipitate is filtered, washed, dried and heated strongly to get pure alumina.

$$2\ Al(OH)_3 \xrightarrow{\text{Strong heating}} Al_2O_3 + 3\ H_2O$$

(*ii*) **Electrolysis of alumina.** Pure alumina is mixed with cryolite and melted in an iron tank. Cryolite lowers down the melting temperature of bauxite. The inside coke lining act as a cathode and carbon rods are used as an anode. When current is passed through the cell the mixture melts (because of the heat generated due to the resistance offered by the mixture). Molten mixture is then electrolysed. The separated aluminium is collected at the bottom of the cell.

$$Al_2O_3 \xrightarrow{\text{Melt}} 2\ Al^{3+} + 3O^{2-}$$

At cathode $Al^{3+} + 3e^- \rightarrow Al$

At anode $O^{2-} - 2e^- \rightarrow O$

$O + O \rightarrow O_2$

10.15. Uses of Aluminium

(*i*) It is used for making household cooking utensils as it is good conductor of heat and resists corrosion.

(*ii*) It is used for making overheat electricity transmission wires and for winding the moving coils of dynamos or motors as it is a good conductor of electricity.

(*iii*) Thin foils of aluminium are used in packaging food materials and medicines.

(*iv*) Being a light metal, it is used in making bodies and parts of aeroplanes, ships, cars, trucks etc.

10.16. Alloys. Alloy is a uniform mixture of one metal with one or more other metals or non-metals.

10.17. Alloys of copper.

Name of alloy	*Mass percent of constituent*	*Some uses*
1. Brass	Cu = 60 to 80 Zn = 40 to 20	For making cooking utensils, condenser sheets, pipes, hardware, cartridge castings, ornaments etc.
2. Bronze	Cu = 75 to 90 Sn = 25 to 10	For making utensils, coins, statues, hardware
3. Aluminium bronze	Cu = 88 to 90 Al = 12 to 10	For making utensils, coins, jewellery, photoframes.
4. Gun metal	Cu = 87, Sn = 10 Zn = 3	Guns, gears, castings
5. German silver (does not contain silver)	Cu = 60, Zn = 20 Ni = 20	For electroplating, silver ware, jewellery.
6. Monel metal	Cu = 28, Ni = 67 Fe = 5	For table tops, sinks, utensils, door and window screens, in chemical industries for tanks, boilers etc.

10.18. Steel alloys or Alloys of iron

Name of alloy	*Mass percent of constituents*	*Some uses*
1. Stainless steel	Fe = 73, C = 1, Cr = 18, Ni = 8	For making blades of knives, kitchen pots, pans, food machinery, automobile parts, laundry machines.
2. Invar	Fe = 63, C = 1, Ni = 36	For making meter scales, pendulum rods
3. Duriron	Fe = 84.7, C = 0.8 Si = 14.5	Laboratory drains and apparatus
4. Tungsten steel	Fe = 75 – 81 W = 20 – 14 Cr = 1, C = 1	Lathe tools
5. Manganese steel	Fe = 85 – 87, C = 1, Mn = 14 – 12	To make brake shoes, the steel jaws of rock crushers, safes and steam shovel teeth

10.19. Compounds

(*i*) **Common salt.** Common salt is a compound of sodium and chlorine.

Preparation. It is obtained mainly from sea water. On the sea coasts, in small tanks and pits, sea water is allowed to dry under summer heat and the salt is purified by repeated crystallisation.

In some places it is mined from salt rocks. Pure sodium chloride, or the commonly known table salt is prepared by passing hydrochloric acid gas through a saturated solution of commercial salt.

Properties.

(*i*) When pure, its density is 2.17 and m.pt. 800°C.

(*ii*) It is insoluble in alcohol.

(*iii*) When kept open, absorbs moisture from air. This is because of the presence of magnesium chloride in common salt. Magnesium chloride is deliquescent, that is, it absorbs water.

Uses.

(*i*) It is an essential ingradient in our daily meal.

(*ii*) It is used in the manufacture of hydrochloric acid and sodium carbonate.

(*iii*) It is used in the salting process of soap.

(*iv*) It is used in the freezing mixtures to lower down temperature of ice.

(II) Sodium Carbonate (Na_2CO_3).

Sodium carbonate is commercially known as soda or washing soda. Although small amount of it is found in nature also, but major demand of it is fulfilled by manufacturing.

Preparation. Soda is manufactured today almost entirely by the solvay or ammonia soda process. In this process, carbon dioxide gas and ammonia gas are passed through a saturated brine solution (sodium chloride solution)

$$NH_3(g) + H_2O\,(l) + CO_2(g) \rightarrow \underset{\text{Ammonium bicarbonate}}{NH_4HCO_3(aq)}$$

$$NH_4HCO_3(aq) + NaCl\,(aq) \rightarrow NH_4Cl\,(aq) + \underset{\text{Ammonium chloride}}{NaHCO_3(s)}$$

Thus sodium chloride gets converted to sodium bicarbonate. Sodium bicarbonate because of its low solubility remains as residue and can be separated from the soluble ammonium chloride simply by filtration. Sodium bicarbonate gets converted to sodium carbonate on heating.

$$2NaHCO_3(s) \xrightarrow{heat} \underset{\text{sodium carbonate}}{Na_2CO_3(s)} + H_2O(g) + CO_2(g)$$

Properties of Sodium Carbonate

(i) Sodium carbonate is a white crystalline solid. The common washing soda is decahydrate $Na_2CO_3 \cdot 10H_2O$

(ii) It is efforescent and loses nine molecules of water on being left in air, forming monohydrate, $Na_2CO_3 \cdot H_2O$

(iii) **Action of Heat.** *On heating, it first loses water* molecules becoming anhydrous and finally melts at 1125 K without decomposition.

(iv) **Solubility.** It is soluble in water and its aqueous solution is alkaline (i.e. turns red litmus blue) due to hydrolysis.

$$Na_2CO_3(s) + 2\,H_2O\,(l) \rightarrow 2\,NaOH\,(aq) + H_2CO_3(aq)$$

(v) **Action of acids.** *It produces effervescene with mineral acids forming* the corresponding salts :

$$Na_2CO_3(s) + 2\,HCl\,(aq) \rightarrow 2\,NaCl\,(aq) + H_2O(l) + CO_2(g)$$

$$Na_2CO_3(s) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + H_2O(l) + CO_2(g)$$

Uses

(i) **Sodium carbonate is consumed in very large quantities in the manufacture of glass and soap.**

(*ii*) It is also used for the manufacture of many other important sodium compounds such as caustic soda, borax, sodium phosphate, water glass etc.

(*iii*) It is most common domestic cleansing agent.

(*iv*) It is used as water softener.

(*v*) It is used in the laboratory as a reagent, for example, as a standard base in acid-base titrations.

(*III*) **Sodium Bicarbonate** ($NaHCO_3$)

Sodium bicarbonate or sodium hydrogen carbonate is commercially known as baking soda.

Preparation. Sodium bicarbonate is obtained by passing carbon dioxide through a cold saturated solution of sodium carbonate :

$$Na_2CO_3(aq) + CO_2(g) + H_2O(l) \rightarrow 2NaHCO_3(aq)$$

On large scale, it is obtained as an intermediate in the solvay process.

Properties.

(*i*) It is a white solid.

(*ii*) It is stable in dry air.

(*iii*) It gets converted to sodium carbonate on heating at a temperature of 573 K.

$$2NaHCO_3(s) \xrightarrow{573K} Na_2CO_3(s) + CO_2(g) + H_2O(l)$$

(*iv*) It is soluble in water and its aqueous solution in a weak base.

Uses

(*i*) Its principal use is in baking powders.

(*ii*) It is also used in the manufacture of aerated water i.e., soda water etc.

(*iii*) Sodium bicarbonate is used as pharmaceutical agent i.e., for neutralization of stomach acidity.

(*iv*) It is used for the preparation of effervescent powders.

(*IV*) **Bleaching powder** ($CaOCl_2$).

The chemical name of bleaching powder is Calcium Oxychloride.

Preparation. It is prepared by passing chlorine gas over dry slaked lime.

$$Ca(OH)_2(s) + Cl_2(g) \rightarrow CaOCl_2(s) + H_2O\ (l)$$

The composition of bleaching powder is not correctly represented by the formula $CaOCl_2$, as the above reaction is heterogenous and does not go to completion. Studies of this substance indicate that it is a mixture of variable amount of calcium hypochlorite, calcium chloride, and unchanged calcium hydroxide.

Manufacture. Now a days bleaching powder is manufactured in Bachmann's plant shown in Fig. Slaked lime is poured from the top of the plant and compressed air is also passed. Hot air and chlorine gas are passed from the bottom side of the tower. Slaked like moving downward combines with the upward going chlorine gas and bleaching powder is formed. This is collected at the bottom of the tower.

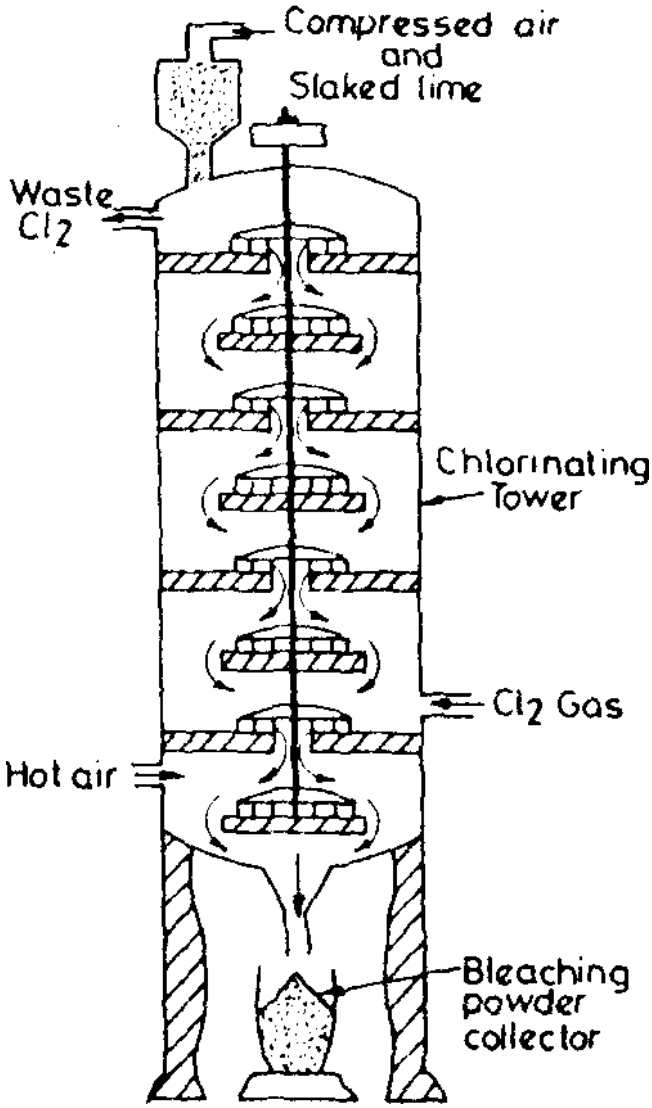


Fig. Bachmann's plant for the manufacture of Bleaching powder

Properties of bleaching powder

(i) Bleaching powder is a yellowish white powder with strong smell of chlorine.

(ii) **Action of air.** In moist air it decomposes gradually under the action of carbon dioxide liberating hypochlorous acid.

$$CaOCl_2(s) + H_2O(g) \rightarrow CaCO_3(s) + 2HClO$$

Hypochlorous acid is not stable and decomposes as

$$2\,HClO \rightarrow 2HCl + O_2$$

(iii) **Action of acid :** Dilute acids react with bleaching powder liberating chlorine.

$$CaOCl_2(s) + 2\,HCl\,(aq) \rightarrow CaCl_2(aq) + HClO + HCl$$

$$HClO \rightarrow HCl + O$$

$$2HCl + O \rightarrow H_2O + Cl_2$$

$$\overline{CaOCl_2(s) + 2\,HCl\,(aq) \rightarrow CaCl_2(aq) + Cl_2(g) + H_2O\,(l)}$$

In fact bleaching action of bleaching powder is because of the evolution of nascent oxygen.

The quality of bleaching powder is evaluated by its "active chlorine" content i.e., by the amount of chlorine liberated under the action of hydrochloric acid. Active chlorine content is expressed as per cent of the total mass of the product. Standard bleaching powder contains about 35 per cent of active chlorine.

Uses. Bleaching powder is a convenient source of releasing chlorine. This powder is used

(*i*) For the manufacture of chloroform.

(*ii*) For bleaching of cotton, linen and wood pulp in textile and paper industry.

(*iii*) For disinfecting lavatories, drainages, ditches etc.

(*iv*) For sterilization of drinking water, and

(*v*) For rendering wool unshrinkable.

(*V*) **Plaster of Paris.** The chemical name of plaster of Paris is calcium sulphate hemihydrate, $CaSO_4 \cdot \frac{1}{2}H_2O$ or $(CaSO_4)_2 \cdot H_2O$

Preparation. Plaster of Paris is prepared by heating gypsum (a naturally occurring sulphate of calcium, $(CaSO_4 \cdot 2H_2O)$ at 373 K.

$$\underset{\text{gypsum}}{CaSO_4 \cdot 2H_2O\,(s)} \xrightarrow{373K} CaSO_4 \cdot \tfrac{1}{2}H_2(O)\,(s) + \tfrac{3}{2}H_2O\,(g)$$

Caution. Gypsum if heated above 393 K loses all the water of hydration and mass so obtained is called dead burnt plaster.

Properties of Plaster of Paris

(*i*) It is a white powder.

(*ii*) It absorbs water at ordinary temperature with a considerable evolution of heat.

(*iii*) When mixed to a paste with water, it solidifies rapidly into a solid mass consisting of fine fibrous gypsum crystals.

Uses.

(*i*) Plaster of Paris is used in making casts and patterns for moulds and statues.

(*ii*) It is used as a cement in ornamental casting and for making decorative materials.

(*iii*) it is also used as a fire proofing materials and for making chalks.

(*iv*) It is used in hospitals for immobilising the affected part in case of bone fracture or sprain.

10.20. Metals in the living system. Some metals are vital for the living system. For example iron is constituent of haemoglobin which transports oxygen in man and other animals. Copper and zinc are the constituents of enzymes. Sodium and potassium are involved in the electrical activity in nerves and in muscle contraction.

Although metals in traces are useful to our body, their presence in greater quantities has poisonous effects. For example : Anaemic condition is often remedied using iron tablets. But excess of iron can lead to siderosis. This disease is observed in Bantu tribes in Africa as they brew their beer in iron pots.

10.21. Non-metals. The non-metals have been placed on the right side of the periodic table. Only the non-metal hydrogen has been placed on the left side in the periodic table.

10.22. Physical Properties

(*i*) Non-metals are usually brittle and do not give sheets or wires.

(*ii*) Non-metals do not possess luster.

(*iii*) They have usually low densities.

(*iv*) Non-metals are generally bad conductors of heat and electricity. Unlike metals non-metals have no free electrons. Graphite is an exception and is good conductor of electricity.

10.23. Chemical Properties. Non-metals are electro-negative. They have a tendency to accept electrons and become negatively charged ions.

(*i*) **Reaction with oxygen.** Non-metals form covalent oxides with oxygen. Some of these oxides on dissolution in water form acids.

$$CO_2 + H_2O \rightarrow H_2CO_3$$

(Carbonic acid)

$$SO_2 + H_2O \rightarrow H_2SO_3$$

(Sulphurous acid)

Other oxides like CO, N_2O, NO, H_2O are neutral.

(*ii*) **Reaction with acids.** Non-metals do not replace hydrogen in acids. This is due to the fact that non-metals cannot give electrons to reduce the hydrogen ions of the acid into hydrogen gas.

(*iii*) **Reaction with chlorine.** Non-metals form chlorides with chlorine having covalent bonds.

$$P_4 + 6Cl_2 \rightarrow 4PCl_3$$

(Phosphorus trichloride)

(*iv*) **Reaction with hydrogen.** Non-metals combine with hydrogen to form hydrides e.g. H_2S, NH_3, HCl, CH_4 etc. These hydrides are formed by electron sharing (covalent bonding).

10.24. Silicon. The element silicon is next to oxygen in abundance in the earth crust. Silicon exists in two allotropic forms – the amorphous silicon and the crystalline silicon.

Amorphous silicon

Preparation. It is prepared by heating well-powdered quartz of finely divided silica with magnesium powder.

$$SiO_2 + 2Mg \rightarrow Si + 2MgO$$

Crystalline silicon. It is prepared by heating silicofluoride with aluminium or zinc to red heat.

$$3K_2SiF_6 + 4Al \rightarrow 4AlF_3 + 6KF + 3Si$$

$$K_2SiF_6 + 2Zn \rightarrow 2ZnF_2 + 2KF + Si$$

Properties

(*i*) It burns on heating and combines with oxygen forming white solid silica (sand).

$$Si + O_2 \rightarrow SiO_2$$

(*ii*) Amorphous silicon combines with chlorine at 450°C to form silicon tetrachloride.

$$Si + 2Cl_2 \rightarrow SiCl_4$$

(*iii*) It reacts with boiling water or steam, producing silicon dioxide and hydrogen.

(*iv*) It reacts with hydrochloric acid forming silicon tetrachloride and hydrogen.

$$Si + 4\,HCl \rightarrow SiCl_4 + 2H_2$$

(*v*) Silicon dissolves in warm sodium hydroxide solution evolving hydrogen.

$$2NaOH + Si + H_2O \rightarrow Na_2SiO_3 + 2H_2$$

(*vi*) It undergoes fusion with sodium carbonate.

$$Na_2CO_3 + Si \rightarrow Na_2SiO_3 + C$$

10.25. Uses of silicon

(*i*) It is used in the preparation of some important alloys, e.g. ferro-silicon, silico-bronze, etc. Ferro-silicon is used for the manufacture of apparatus for redistilling nitric acid. Silico-bronze is used in the manufacture of telegraph and telephone wires.

(*ii*) It is used as deoxidizer in making casting of steel, copper and bronze.

10.26. Phosphorus. Phosphorus does not occur free in nature, because it is highly reactive element. It is quite abundant on earth. It is present in all living things – both plants and animals. In our body phosphorus is present in bones, muscles and nerve tissues.

Preparation. Phosphorus is obtained by heating rock phosphate with sand and coke.

$$\underset{\text{calcium phosphate}}{2Ca_3(PO_4)_2} + 6SiO_2 \rightarrow 6\ CaSi_3O + P_4O_{10}$$

Calcium phosphate

$$P_4O_{10} + 10C \rightarrow P_4 + 10CO$$

10.27. Allotropes of phosphorus. Phosphorus occurs in two allotropic forms :

(i) White or yellow phosphorus

(ii) Red phosphorus

Both white phosphorus and red phosphorus are solids at room temperature. Red phosphorus is more stable than white phosphorus. White phosphorus can be converted into red phosphorus by heating to 250°C in an inert atmosphere of carbon dioxide.

Phosphorus molecules are non-polar, therefore, both white phosphorus and red phosphorus are insoluble in polar solvent, water. White phosphorus is soluble in carbon disulphide but red phosphorus is insoluble in it.

Chemical Properties

(*i*) *Reaction with oxygen.* Yellow phosphorus spontaneously combines with oxygen. When white phosphorus is exposed to air, it catches fire to give phosphorus pentoxide. It is for this reason that white phosphorus is kept under water.

$$P_4 + 3O_2 \rightarrow \underset{\text{(Phosphorus trioxide)}}{2P_2O_3}$$

$$P_4 + 5O_2 \rightarrow \underset{\text{(Phosphorus pentoxide)}}{P_4O_{10}}$$

(*ii*) *Reaction with chlorine.* Both allotropes of phosphorus react with chlorine gas to form tri- and pentachlorides. Yellow phosphorus react violently at room temperature whereas red phosphorus react on heating only.

$$P_4 + 6\ Cl_2 \rightarrow \underset{\text{(Phosphorus trichloride)}}{4PCl_3}$$

$$P_4 + 10\ Cl_2 \rightarrow \underset{\text{(Phosphorus pentachloride)}}{4PCl_5}$$

(*iii*) *Reaction with sodium or potassium hydroxide.* Red phosphorus does not react but yellow phosphorus reacts with hot and concentrated solution of sodium or potassium hydroxide. In this reaction phosphene gas (PH_3) is produced. It is highly toxious gas.

(*iv*) Phosphorus reduces nitric acid to nitrogen dioxide and is itself oxidised to phosphoric acid.

$$P_4 + 20HNO_3 \rightarrow \underset{\text{(Phosphoric acid)}}{4H_3PO_4} + 20NO_2 + 4H_2O$$

10.28. Sulphur. Sulphur occurs in nature both in the combined and free state. In the combined state it is constituent of many important metallic minerals is like cinnabar (HgS), zinc blende (ZnS), copper pyrites ($CuFeS_2$). etc.

Allotropic form of sulphur. There are three important allotropic forms of sulphur.

(*i*) Rhombic sulphur (Octahedral sulphur)

(*ii*) Monoclinic sulphur (Prismatic sulphur)

(*iii*) Plastic sulphur

Properties

(*i*) Sulphur is a pale yellow solid.

(*ii*) Sulphur molecules are non-polar, so they are slightly soluble in polar solvent water.

(*iii*) Sulphur is soluble in organic solvents like carbon disulphide.

(*iv*) *Formation of sulphides.* Sulphur forms sulphides with many metals like iron, copper, zinc, antimony etc.

$$Fe + S \rightarrow FeS$$

$$Mg + S \rightarrow MgS$$

Boiling sulphur reacts with hydrogen gas forming hydrogen sulphide gas

$$H_2 + S \rightarrow H_2S$$

At high temperature sulphur combines with carbon forming carbon disulphide

$$C + 2S \rightarrow CS_2$$

(*v*) *Oxidation by acids.* Sulphur is oxidised by oxidising acids like sulphuric and nitric acid with hot and concentrated sulphuric acid it forms sulphur dioxide.

$$S + 2H_2SO_4 \rightarrow 2H_2O + 3SO_2$$

With concentrated nitric acid it forms sulphuric acid.

$$S + 6\,HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$$

Uses of sulphur

(*i*) Sulphur is used in the manufacture of sulphur dioxide, sulphuric acid, matches etc.

(*ii*) It is used for volcanization of rubber

(*iii*) It is used for destroying bacteria, fungi, insects etc.

(*iv*) It is used in the manufacture of bisulphites of calcium and magnesium which are used as bleaching agents.

TEXT-BOOK QUESTIONS

Q. 1. Describe the chemical reactions that take place in the blast furnace.

Ans. For reactions which take place in the blast furnace please refer art..10.12.

Q. 2. How is aluminium extracted from its bauxite ore?

Ans. (*a*) *Purification of bauxite ore.* Bauxite ore is purified by Bayer's method. In this method, the ore is treated with hot sodium hydroxide which forms sodium aluminate which is soluble in water. The gangue do not react with sodium hydroxide and get separated by filtration.

$$Al_2O_3 \cdot 2H_2O + NaOH \longrightarrow 2NaAlO_2 + H_2O$$

Bauxite ore sodium hydroxide sodium aluminate water

Aluminium is precipated in form of aluminium hydroxide.

$$NaAlO_2 + HCl + H_2O \longrightarrow Al(OH)_3 \downarrow + NaCl$$

sodium aluminate Aluminium hydroxide sodium chloride

Aluminium hydroxide is heated strongly to get pure aluminium oxide.

$$2Al(OH)_3 \xrightarrow{\text{heat}} Al_2O_3 + 3H_2O$$

Aluminium oxide (pure)

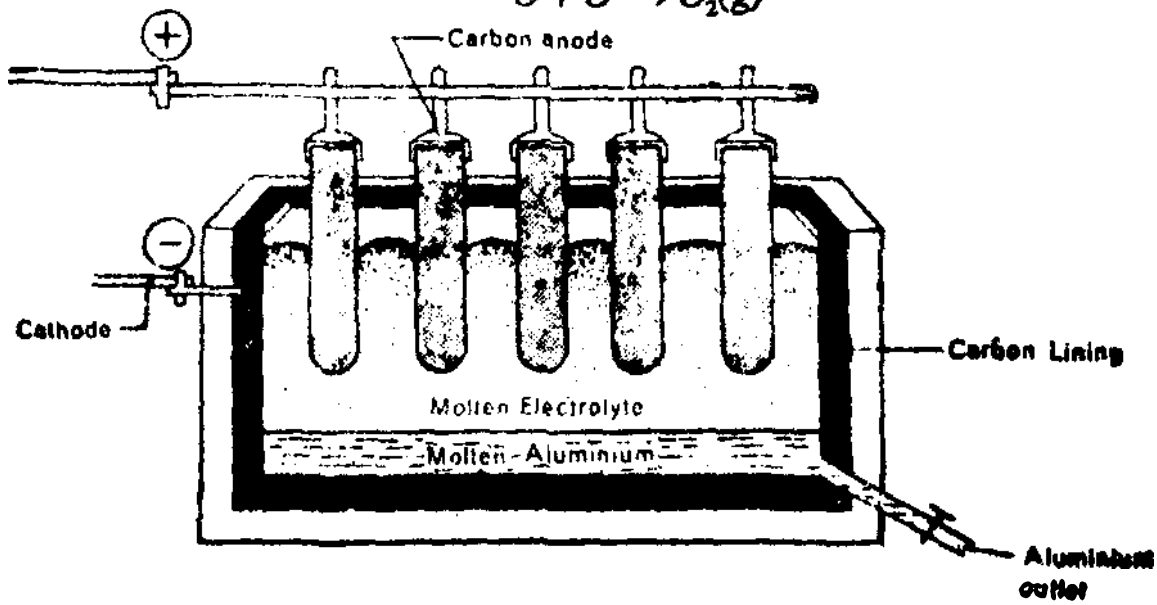
(*b*) **Electrolytic reduction of pure aluminium oxide.** Aluminium oxide is reduced electrolytically in a specially made electrolytic cell. The inside coke lining acts as a cathode and carbon rods are used as an anode. The cell is charged with a mixture of concentrated bauxite ore (purified aluminium oxide) and cryolite. Cryolite is used: (i) to lower down melting point of alumina; (ii) to increase electrical conductivity; (iii) as a solvent. When current is passed through the cell, the mixture melts because of the heat generated due to resistance offered by the mixture. Molten mixture gets electrolysed.

$$Al_2O_3 \xrightarrow{\text{Electrolysis}} 2Al^{3+} + 3O^{2-}$$

At cathode : $Al^{3+} + 3e^- \rightarrow Al(s)$

At anode : $O^{2-} - 2e \rightarrow O$

$O + O \rightarrow O_2(g)$



Aluminium is deposited at cathode which is collected at the bottom of the cell. Oxygen is liberated at anode.

Q.3. What are the common methods of ore concentration ?

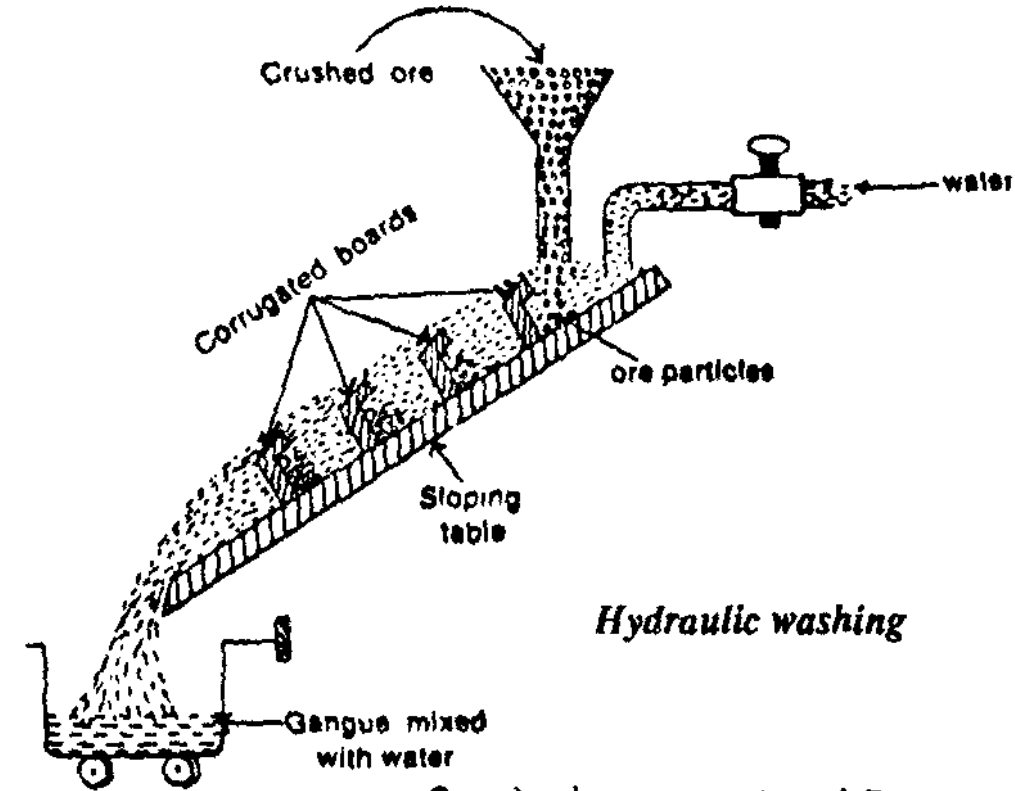
Ans. Common methods of ore concentration are :

(*i*) Hydraulic washing (*iii*) Magnetic separation

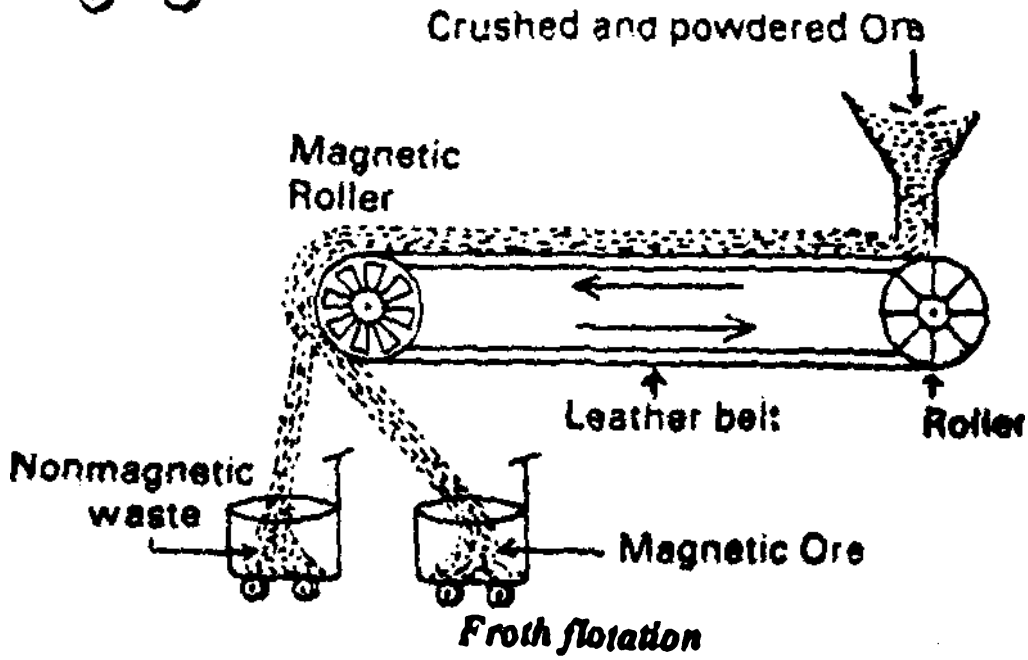
(*ii*) Froth floatation process (*iv*) Chemical separation

(*i*) **Hydraulic washing.** The crushed and ground ore is poured on a wooden table which is fitted with a series of corrugated boards. A stream of water is passed over the shaking table. This turbulent stream of water washes the lighter gangue away while the heavier minerals are retained by the corrugated boards. The scheme is shown in the Figure.

(*ii*) **Froth floatation.** The technique is employed to concentrate sulphide ores. The crushed and powdered ore is taken in a tank. Sufficient quantity of water and a little of foaming agent like pine oil or detergent are added to the tank. Compressed air is blown through the mixture of ore, water and pine oil. The air agitates the mixture and thus froth is formed. These bubbles rise up in the tank. The more valuable denser minerals stick to the bubbles of the foam and rise to the surface. The gangue material is left behind and sinks to the bottom of the tank. The froth containing the sulphide ore is collected in another tank. It is kept for some time so that foam bubbles subside, and concentrated ore is obtained.



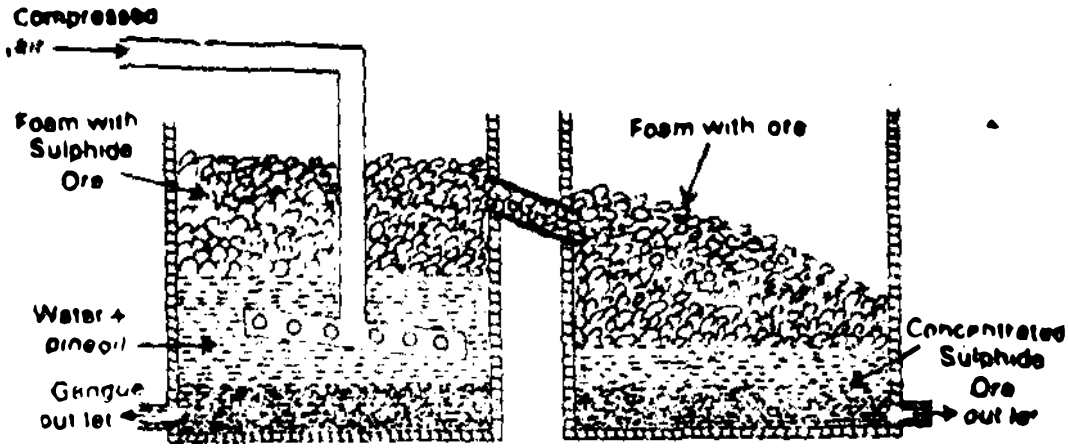
Hydraulic washing



Froth flotation

(*iii*) **Magnetic separation.** The method is used to separate the gangue from the ores containing the metals like iron, chromium, manganese which are attracted by magnets. The crushed and powdered ore is poured on a belt moving over two rollers. One of the rollers is fitted with a magnet. As the ore carried by the moving bell reaches the magnetic roller, the ore containing

magnetic material is attracted or deflected while the gangue is unaffected. Thus, we can separate the gangue from the desired mineral. This is shown in Fig.



(*iv*) **Chemical separation (leaching).** It is a process in which ore is treated with a suitable reagent which reacts with the ore but not with impurities The impurities are insoluble and can be filtered off.

The purified mineral is obtained by chemical reactions. For example powdered silver ore is treated with dilute potassium cyanide which dissolves silver ore to form complex, potassium argento cyanide (soluble in water). The solution is separated and treated with scrap zinc when silver is precipitated.

$$Ag_2S + 4KCN \longrightarrow 2K[Ag(CN)_2] + K_2S$$

Silver sulphide Potassium cynide Potassium sulphide

$$2K[Ag(CN)_2] + Zn \longrightarrow K_2[Zn(CN)_4] + 2Ag$$

Potassium argento cyanide Potassiuum zinc cyanide silver

Q. 4. Compare and contrast the properties of metals and non-metals.

Ans. Comparison of properties of metals and nonmetals

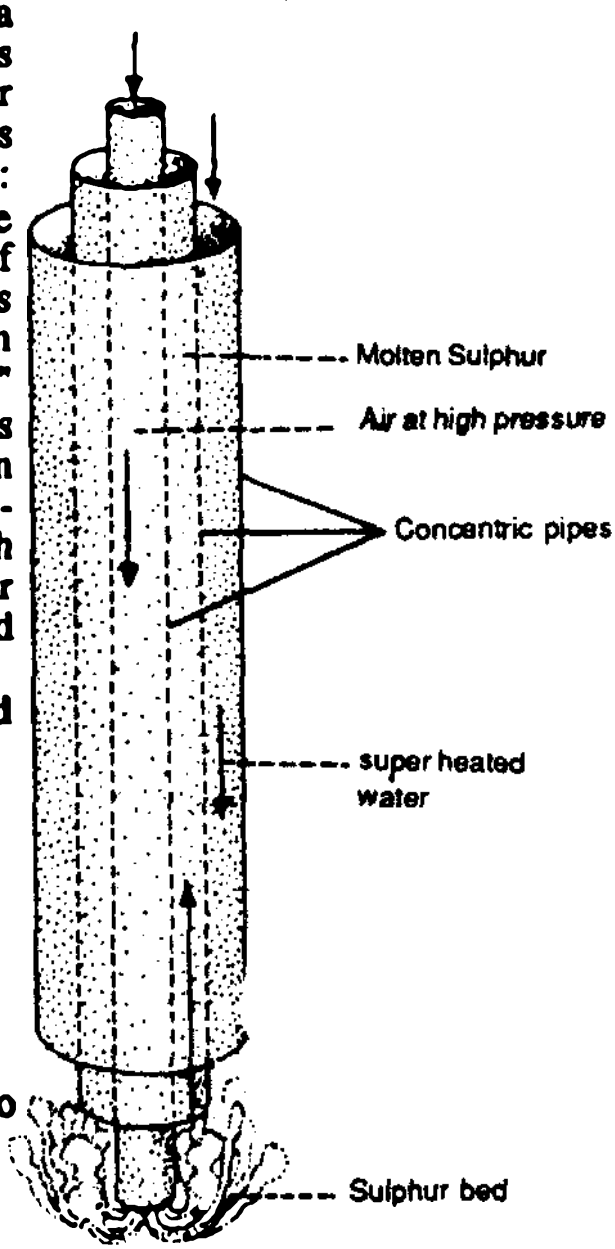
Metals	*Non-metals*
Physical Properties	**Physical Properties**
1. *Physical State.* All metals are solids except mercury at room temperature. Metals have usually high melting and boiling points.	1. Nonmetals are either solids with low melting and boiling points or gases. Only bromine is liquid.

Metals	*Non-metals*
2. *Metallic Lustre.* Metals have a shining appearance and can be polished.	2. Nonmetals are dull and cannot be polished.
3. *Conduction.* Metals are good conductors of heat and electricity.	3. Nonmetals are bad conductors of heat and electricity (except graphite).
4. *Malleability.* Metals are malleable, i.e., they can be beaten into thin sheets.	4. Nonmetals are brittle, i.e., they become powder when beaten.
5. *Ductility.* Metals are ductile, i.e., they can be drawn into wires.	5. Nonmetals are non-ductile.
6. *Hardness and tensile strength.* Most of the metals are hard and possess great tensile strength.	6. Nonmetals are usually soft and possess little tensile strength.
7. *Density.* Metals have high density.	7. Nonmetals have low density.
8. *Sonorousity.* Metals are usually sonorous i.e. give a musical sound when struck.	8. Nonmetals are not sonorous.
Chemical Properties	**Chemical Properties**
9. *Valency.* These usually possess positive valency.	9. These possess negative valency.
10. These have usually tendency to lose electrons.	10. They have tendency to gain electrons.
11. *Oxides.* Oxides of metals are usually basic some are amphoteric.	11. Oxides of nonmetals are either acidic or neutral.
12. *Halides.* Chlorides of metals are true salts.	12. Chlorides of nonmetals are not true salts.
13. *Hydrides.* Hydrides of metals are ionic, unstable and reactive.	13. Hydrides of nonmetals are stable and covalent in nature.
14. *Reaction with acids.* Metals usually replace hydrogen from dilute non-oxidising acids like HCl and H_2SO_4. Exceptions are copper, silver and gold	14. Non metals do not replace hydrogen.

Q. 5. Describe the Frasch process to obtain sulphur.

Ans. Sulphur bed is present about a depth of 1000 feet below the earth. It is mixed with clay, sand and many other gases like H_2S and SO_2. Free sulphur is extracted by Frasch's process as follows :

Three concentric pipes are put in the boring under the earth. The diameter of three pipes are 12.6 and 1 inches respectively. Superheated steam (180°C) is passed through the 12" diameter pipe and hot compressed air is passed from the 1" diameter pipe. When sulphur melts under earth, molten sulphur and water mixutre comes up through the middle pipe (6") in form of sulphur foam. Sulphur obtained by this method is further purified.



Q.6. How is copper extracted from its sulphide ore ?

Ans. Please see art 10.8.

Q.7. Write short notes on :

1. **Allotropes of phosphorus**
2. **Effect of heat on sulphur**
3. **Reactivity series of metals**
4. **Froth floatation process**
5. **Uses of silicon**

Ans. (1) Phosphorus occurs in two chief allotropic forms.

(*i*) White or yellow phosphorus

(*ii*) Red phosphorus

Both white phosporous and red phosphorus are solids at room temperature. Red phosphorus is more stable than white phosphours. The difference between red and yellow phosphorus is mainly due to the fact that in red phosphorus the bonding between phosphorus atoms is strong whereas in yellow phosphorus bonding is weak.

Properties of white phosphorus

Physical.

(*i*) Its density is 1.8 g/cm^3

(*ii*) Its melting point is 44°C

(*iii*) It is soluble in carbon disulphide

(*iv*) It ignites in moist air at 30°C

Chemical.

(*i*) *Burning.* Ignition temperature of white phosphorus is very low (35°C), therefore, when white phosphorus is exposed to air it catches fire to give phosphorus pentoxide.

$$P_4 + 5O_2 \rightarrow \underset{\text{Phosphorous pentoxide}}{P_4O_{10}}$$

(*ii*) *Phosphorescence.* When white phosphorus is kept in dark but in contact with air, it undergoes slow combustion and glows in the dark. The property of glowing of white phosphorus in the dark is called phosphorescence.

(*iii*) *Reaction with chlorine.* White phosphorus burns in chlorine to give phosphorus trichloride.

$$P_4 + 6\,Cl_2 \rightarrow 4PCl_3$$

If excess of chlorine is used, phosphorus pentachloride is obtained.

$$P_4 + 10Cl_2 \rightarrow \underset{\text{Phosphorous pentachloride}}{4PCl_5}$$

(*iv*) *Reaction with caustic soda.* White phosphorus dissolves in caustic soda on boiling in an inert atmosphere to give phosphine gas.

$$P_4 + 3NaOH + 3H_2O \rightarrow \underset{\text{Phosphine}}{PH_3} + \underset{\text{sodium hypophosphite}}{3NaH_2PO_2}$$

Properties of red phosphorus

Physical

(*i*) Its density is 2.3 g/cm^3

(*ii*) It sublimes at 400°C

(*iii*) It is insoluble in carbon disulphide

(*iv*) It ignites in air at 260°C

Chemical

(*i*) *Burning.* The ignition temperature of red phosphorus is very high (260°C), therefore, red phosphorus burns in air only on heating to give phosphorus pentoxide.

(*ii*) *Phosphorescence.* Red phosphorus does not show phosphoreseeace.

(*iii*) *Reaction with chlorine.* Red phosphorus reacts with chlorine on heating to give phosphorus trichloride and phosphorus pentachloride.

(*iv*) *Reaction with caustic soda.* Red phosphorus does not react with caustic soda.

2. Effect of heat on sulphur

Place some powdered sulphur in a narrow test tube and heat it gently. Observe the stages through which sulphur passes.

(*a*) At 112.8°C, it melts and, on increasing temperature, the liquid becomes reddish brown in colour. It is mobile.

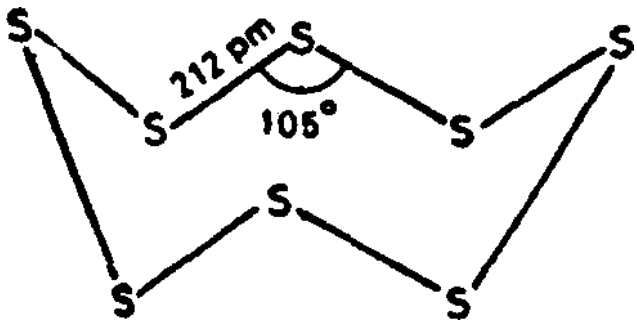
(*b*) At 250°C, it becomes very thick and cannot be poured.

(*c*) At 300°C, it again becomes mobile amber coloured liquid.

(*d*) At 445°C, it boils giving yellowish orange vapours.

The reason for these observation is as follows :

Sulphur molecules exist in the form of 8-membered ring-like strucutre. When heated, the rings break. But later on, as we go on heating, the broken pieces intermingle with each other forming thick viscous liquid. Intense heating later breaks the molecules into smaller parts with the result that the liquid sulphur starts boiling.



3. Reactivity series of metals

The arrangement of metals in a vertical column in the order of decreasing reactivities is called reactivities series of metals. In the reactivity series, the most reactive metal is placed at the top whereas the least reactive metal is placed at the bottom.

Also please see art 10.3.

4. Froth Floatation Process. Please see Q. (3).

5. Uses of silicon

(*i*) It is used in the preparation of silicones (polymer) in various alloys of iron, aluminium, copper and manganese. It is used in semi-conductor devices.

(*ii*) Silicon carbide is used in cutting and griding tools.

(*iii*) Silicon dioxide is used in making glass and cement.

Q. 8. Give reasons.

1. Gold and silver often occur in native state.

2. Yellow phosphorus is kept in water.

3. Metals replace hydrogen from acid whereas non-metals do not.

4. Common salt absorbs moisture from air.

5. Cryolite is added to bauxite prior to electrolysis.

6. Titanium is called as a strategic metal.

7. Carbonates and sulphide ores are usually converted into oxides.

Ans. 1. Gold and silver often occur in native state because they are least reactive and do not react with most of chemicals. They are not affected by atmospheric conditions.

2. Yellow phosphorus is kept in water because it is unstable. It catches fire in moist air at 30°C due to oxidation.

3. Metals replace hydrogen from acids because they can supply electrons to H^+ ions of an acid. Non-metals cannot replace hydrogen from acids because they cannot supply electrons to H^+ ions of an acid. A non-metal being an electron acceptor cannot supply electron to H^+ ions.

4. Common salt obtained from the sea-water contains magnesium chloride also. Magnesium chloride is deliquescent substance, that is, it absorbs moisture from atmosphere. Common salt absorbs moisture from air due to presence of magnesium chloride.

5. Cryolite is added to bauxite prior to electrolysis so as to reduce melting point of bauxite. Secondly, it increases electrical conductivity and acts as a solvent.

6. Titanium metal and its alloys are used in (*a*) aero-space, (*b*) Aircraft frames and engines, (*c*) military hardware, (*d*) marine equipment, (*e*) chemcial reactors and hence (*f*) chemical industries.

Titanium is called as a strategic metal due to its special applications as mentioned above.

7. Carbonates and sulphide ores are usually converted into oxides because it is easier to reduce oxides to get free metal.

Q. 9. Match the compounds with their uses.

Compound	Uses
Sodium carbonate	For white washing
Sodium bicarbonate	For making casts
Calcium oxide	For softening hard water
Silicon carbide	For making baking powder
Plaster of Paris	For cutting and grinding

Ans.

Compound	*Uses*
Sodium carbonate	For softening hard water
Sodium bicarbonate	For making baking powder

Calcium oxide	For white washing
Silicon carbide	For cutting and grinding
Plaster of Paris	For making casts

Q. 10. State what happens when :

1. Silicon is dissolved in warm sodium hydroxide solution.

2. Hydrogen gas and boiling sulphur are brought together.

3. Hot and concentrated sulphuric acid is poured on sulphur powder.

4. Steam is passed over hot silicon

5. Yellow phosphorus is mixed with hot and concentrated solution of sodium hydroxide.

6. Ore cinnabar is roasted in a furnance.

Ans. 1. Silicon dissolves in warm sodium hydroxide solution evolving hydrogen.

$$2NaOH + Si + H_2O \rightarrow Na_2SiO_3 + 2H_2$$

2. When hydrogen gas and boiling sulphur are brought together, small amount of hydrogen sulphide is obtained.

$$H_2 + S \rightarrow H_2S$$

3. *Sulphur is oxidised to sulphur dioxide by hot and concentrated* sulphuric acid.

$$S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$$

4. Red hot silicon decomposes steam producing silicon dioxide and hydrogen.

$$Si + 2H_2O \rightarrow SiO_2 + 2H_2$$

5. White phosphorus dissolves in hot and concentrated solution of sodium hydroxide to give phosphine gas.

$$P_4 + 3\,NaOH + 3\,H_2O \rightarrow PH_3 + 3NaH_2PO_2$$

6. On roasting ore cinnabar in a furnance, mercuric oxide first formed by oxidation of cinnabar, decomposes at about 300°C to give mercury.

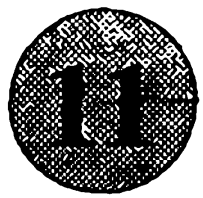
$$2HgS + 3O_2 \rightarrow 2HgO + 2SO_2$$

$$2HgO \rightarrow 2Hg + O_2$$

Q. 11. Fill in the blanks :

1. ———— is the most abundant metal in the earth's crust.
2. Stainless steel contains _____, ———— and _____.
3. Solder is an alloy of _____ and _____.
4. Constituents of German silver are _____, _____ and _____.
5. Electromagnets are used to concentrate _____ ores.
6. Nitric acid oxidizes sulphur to _____.
7. Most abundant non-metal in the earth's crust is _____.
8. Phosphorus with chlorine forms two chlorides namely _____ and _____.
9. _____ is the best conductor of heat.
10. An alloy _____ is used for aircrafts.

Ans. 1. Aluminium
2. iron, nickel, chromium
3. Lead, tin
4. copper, nickel, zinc
5. magnetic
6. sulphuric acid.
7. oxygen
8. phosphorus trichloride, phosphorus pentachloride
9. silver
10. duralium (duralumin).



CARBON AND ITS COMPOUNDS

11.1. Carbon : Symbol = C

Atomic Number = 6

Atomic mass = 12 *Symbolic representation* = $^{12}_{6}C$

11.2. Position of Carbon in the periodic table : The atomic number of carbon is 6, *i.e.* K (2), L (4). It is clear that carbon atom has 4 electrons in the outermost shell (L shell) of its atom. Since carbon has 4 electrons in the outermost shell of its atom, it has been placed in group IV of the periodic table.

11.3. Carbon has large number of compounds in nature. Compounds of carbon are widely distributed in nature. The number of carbon compounds is larger than that of all other elements put together. This is so because carbon is chemically unique. Among all the hundred or so elements known, only carbon atoms have the ability to combine with themselves to form long chains. A long chain, in turn, provides a convenient backbone of atoms to which other atoms can attach themselves in a variety of ways. This is the secret behind the extra-ordinary variety of compounds that the carbon element can make. This property of carbon element is called catenation (self-linking property).

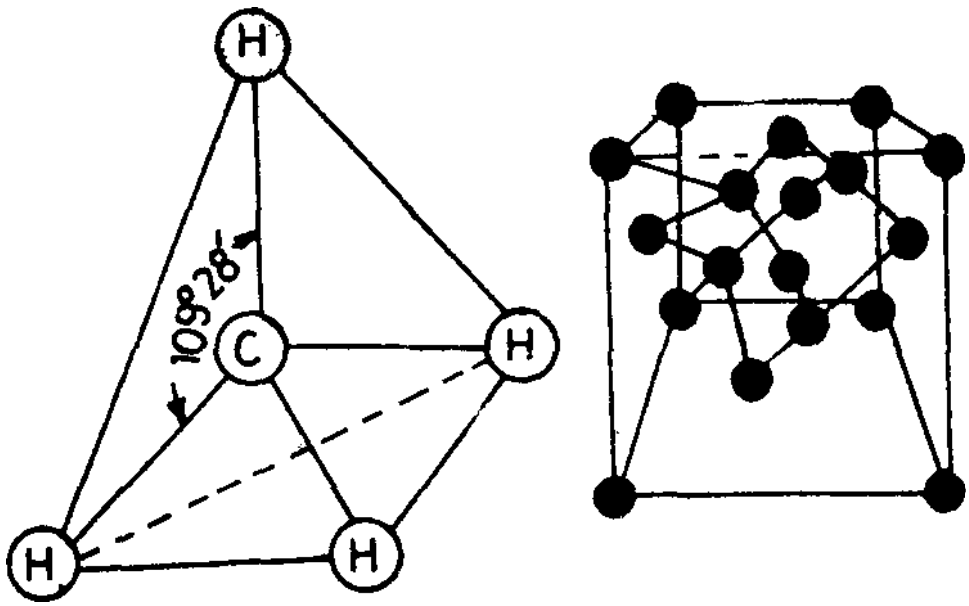
11.4. Diamond and graphite are chemically identical and consist of carbon atoms. When diamond or graphite is strongly heated in air, it burns completely to form carbon dioxide. Equal quantities of graphite and diamond when burnt, produce exactly the same amount of carbon dioxide, leaving no other residue. These results show that diamond and graphite are chemically identical and consist only of carbon atoms.

11.5. Comparison of physical properties of diamond and graphite.

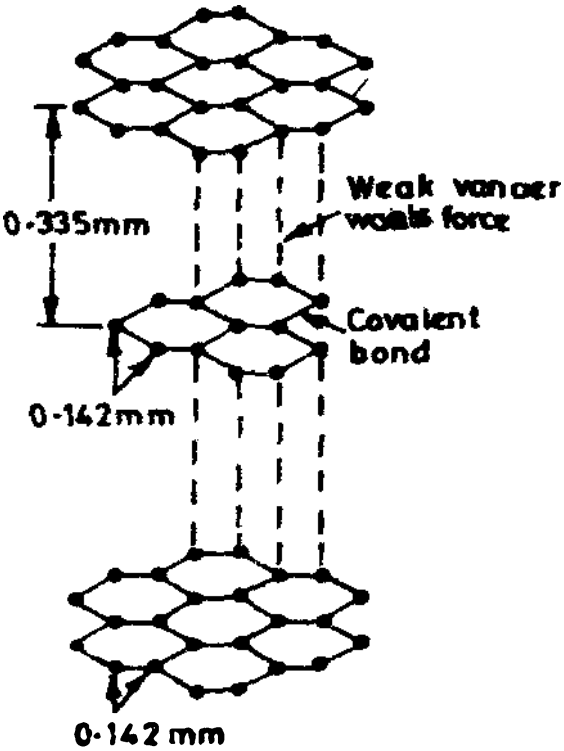
Property	*Diamond*	*Graphite*
Appearance	Transparent	Black, shiny
Hardness	Very hard	Soft, slippery to touch
Thermal Conductivity	Very poor	Moderate
Electrical Conductivity	Poor conductor	Good conductor
Density (kg/m^3)	3,510	2,250
Uses	Jewellery, drilling, grinding.	Dry cell, electric arc, pencil lead, lubricant.

11.6. Reason for different properties of diamond and graphite. This is due to different patterns in which carbon atoms are arranged in diamond and graphite.

11.7. Structure of diamond. In diamond each carbon atom lies at the centre of a regular tetrahedron and is covalently bonded with four carbon atoms located at its four corners (Fig.). All bonding electrons of the carbon atom are thus engaged leaving no free electrons. This makes diamond an extremely poor conductor of electricity. Such a tightly bonded tetrahedral arrangement also produces a rigid three dimensional structure which makes diamond the hardest substance known, and gives it a high density. The melting point of diamond (3500°C) is also very high as melting requires energy to break its strong covalent bonds.



11.8. Structure of graphite. Each carbon atom in graphite is covalently bonded to only three neibouring carbon atoms forming layers of hexagonal networks (Fig.) separated by a comparatively larger distance. Because of this distance between two successive layers, the possibility of covalent bond being formed between carbon atoms lying in opposite layers is ruled out. Their fourth valence electrons thus remain free. Due to this, graphite is a good conductor of electricity. The layers also have the facility to slide over one another. This gives graphite its lubricating properties and makes it feel soft and greasy to touch.



11.9. Uses of diamond and graphite

Uses of diamond

(*i*) They are used in cutting instruments like glass cutters and in rock drilling equipment.

(*ii*) For making jewellery.

(*iii*) Its extraordinary sensitivity to heat rays and ability to faster out harmful radiation make it an excellent material for high precision thermometers and protective windows for space probes.

(*iv*) Sharp-edged diamond provides eye surgeons with a fine tool to remove cataract from eyes with hairbreadth precision.

Uses of graphite

(*i*) It is used as a lubricant for fast moving parts of machinery and for those parts which operate at very high temperatures.

(*ii*) It is used to make electrodes of cells, brushes of electric motors and dynamos, in electric arcs etc.

(*iii*) It is used for making pencils and black paints.

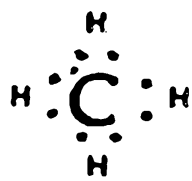
(*iv*) It is used for making crucibles for melting metals in industries.

11.10. Hydrocarbons. Hydrocarbons are compounds of carbon and hydrogen. The number of hydrocarbons is quite large because carbon atoms have the property of forming long chains.

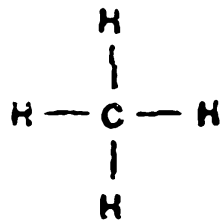
11.11. Natural source of hydrocarbon. The natural source of hydrocarbons is petroleum (crude oil). It is preserved by nature in the reservoirs of porous rocks in the earth.

11.12. Structure of methane. a molecule of methane has four hydrogen atoms to one central atom of carbon.

The carbon atom has four electrons in its outermost orbit. But it can have another, four to complete the set, which means that the valency of carbon is 4 (tetravalent). The carbon atom, therefore, forms a chemical bond with 4 atoms of hydrogen by sharing an electron with each of them. The valency of hydrogen is 1 (monovalent) and each of the 4 hydrogen atoms also share an electron with the carbon atom. A methane molecule thus formed by 4 hydrogen atoms surrounding a carbon atom, in a chemical bond makes for a very stable arrangement. Each pair of electrons shared between two neighbouring atoms constitutes a covalent bond. In methane, carbon forms of our covalent bonds and hydrogen one. A covalent bond indicated by two dots representing electrons, allows us to write its electric formula on the other hand, its structural formula is expressed by representing the covalent bonds by straight lines.



Methane
(electronic formula)



Methane
(structural formula)

11.13. Marsh gas. Methane (CH_4) is called marsh gas, because it is formed by the decomposition of plant and animal matter in marshy areas.

11.14. Preparation of methane. Methane gas is prepared by heating sodium acetate with soda lime.

$$\underset{\text{Sodium acetate}}{CH_3COONa\ (s)} + NaOH\ (s) \longrightarrow \underset{\text{Methane}}{CH_4\ (g)} + Na_2CO_3$$

A mixture of sodium acetate and soda lime (2g each) is taken in a hard glass boiling tube. The boiling is heated, on heating, methane gas is evolved which is collected over water.

Chemical Properties of Methane

(1) Combustion. It burns in air with a bluish flame, producing carbon dioxide and water.

$$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2\,H_2O(g) + \text{heat}$$

(11) **Substitution reactions.** Methane reacts with chlorine in diffused sunlight.

$$CH_4 + Cl_2 \xrightarrow{\text{Sun light}} \underset{\text{monochloro methane}}{CH_3Cl} + HCl$$

$$CH_3Cl + Cl_2 \longrightarrow \underset{\text{Dichloro methane}}{CH_2Cl_2} + HCl$$

$$CH_2Cl_2 + Cl_2 \longrightarrow \underset{\text{Trichloro methane}}{CHCl_3} + HCl$$

$$CHCl_3 + Cl_2 \longrightarrow \underset{\text{Tetra chloro methane}}{CCl_4} + HCl$$

Uses of Methane

(*i*) It is used as fuel for domestic cooking because it burns with evolution of a lot of heat and without smoke.

(*ii*) It is used in the manufacture of carbon black which is used in printer's ink and paints.

(*iii*) It is used for the preparation of methanol, formaldehyde and methyl chloride etc.

11.15. Alkanes. Alkanes (or paraffins) are hydrocarbons in which carbon atom form single bonds with one another. Their general formula is C_nH_{2n+2} where n is the number of carbon atoms.

Name	*Molecular formula*
Methane	CH_4
Ethane	C_2H_6
Propane	CH_3H_8
Butane	C_4H_{10}
Pentane	C_5H_{12}
Hexane	C_6H_{14}

11.16. Properties of Alkanes

Name	*Molecular formula*	*M.P °C*	*B.P. °C*	*State*	*Molecular mass*
Methane	CH_4	–182	–162	Gas	16
Ethane	C_2H_6	–183	–88.6	Gas	30
Propane	C_3H_8	–188	–42.2	Gas	–
Butane	C_4H_{10}	–138	–0.5	Gas	–

Pentane	C_5H_{12}	–130	–36.3	Gas/ liquid	-
Hexane	C_6H_{14}	–95.3	–68.7	–	–

The physical properties of alkanes depend on their molecular mass. alkanes with one to four carbon atoms are gases at room temperature. Those with 6 carbon atoms or more are liquids. Alkanes with larger molecular masses are solids. The melting point and boiling point of alkanes increase with increasing molecular mass. The chief source of alkane is petroleum.

11.17. Isomers. When the number of carbon atoms in a molecule of alkane exceeds 3, more than one arrangement becomes possible. For example, a rearrangement of atoms in the butane molecule shows two distinctly different possibilities (Fig.). In one of them the carbon atoms form a longer chain, while the other has a shorter chain and a branch. These two forms of butane are respectively called normal butane (n-butane) and iso-butane.

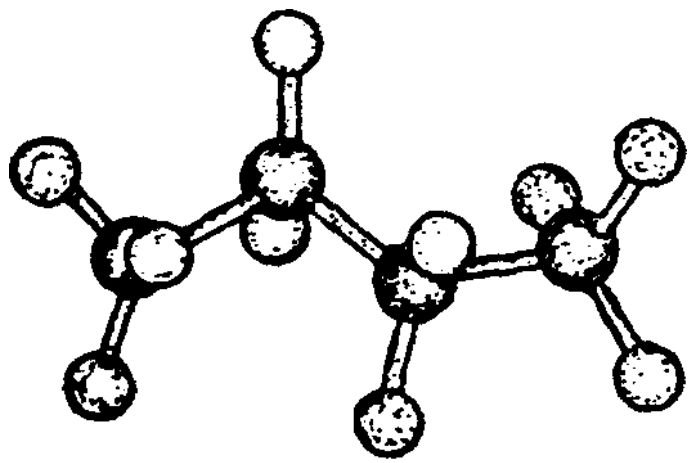
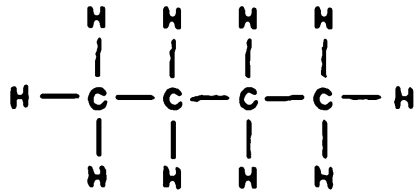
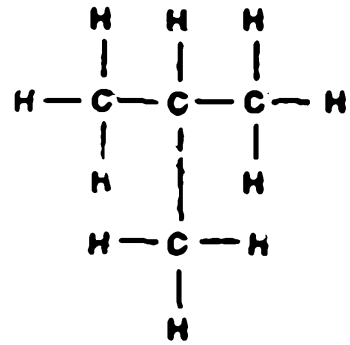


Fig. Model of n-butane



n-butane (C_4H_{10})



iso-butane (C_4H_{10})

Although normal and iso-butane have the same molecular formulae they exhibit different physical properties. In a branched chain at least one carbon atom is bonded to three other carbon atoms. In an unbranched chain no carbon atom is bonded to more than two carbon atoms. The alkanes with unbranched chains are called normal alkanes or *n*-alkanes. Compounds having the same molecular formulae but a different structural arrangement of atoms in them, are known as isomers, and the phenomenon is known as isomerism.

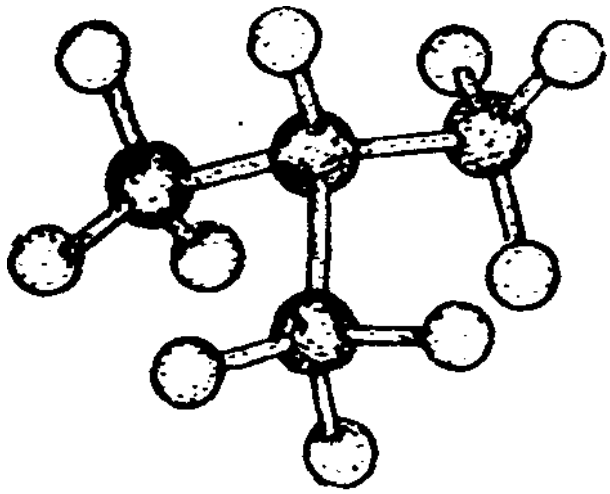


Fig. Model of iso-butane

11.18. Homologous series. A homologous series is a group of organic compounds having similar structures and similar chemical properties in which the successive compounds differ by CH_2 group. The various organic compounds of a homologous series are called homologues.

Homologous Series of Alkanes

Alkane	*Molecular formula*
Methane	CH_4
Ethane	C_2H_6
Propane	C_3H_8
Butane	C_4H_{10}
Pentane	C_5H_{12}

The general formula of the homologous series of alkanes is C_nH_{2n+2} where n is the number of carbon atoms in one molecule of alkane.

11.19. Unsaturated hydrocarbons. A hydrocarbon in which two carbon atoms are connected by a double bond or a triple bond is called an unsaturated hydrocarbon. These hydrocarbons are obtained mostly from petroleum by a process called cracking.

11.20. Cracking of hydrocarbons. Cracking is a process of breaking down large (high, molecular mass) hydrocarbons into smaller ones of lower boiling points. When heated with a catalyst, the process is called thermal cracking, whilst heating in the presence of a catalyst, is called catalytic cracking.

$$\underset{\text{Propane}}{C_3H_8} \longrightarrow \underset{\text{Methane}}{CH_4} + \underset{\text{Ethylene}}{C_2H_4} \longrightarrow 2CH_4 + e$$

11.21. Alkene. A hydrocarbon in which the two carbon atoms are connected by a double bond is called an alkene. The general formula of an alkene is C_nH_{2n} where n is the number of carbon atoms in its one molecule. The names and molecular formulae of the first three alkenes are given below :

Name of alkene	*Formula*
Ethylene (ethene)	C_2H_4 or $CH_2 = CH_2$
Propylene (propene)	C_3H_6 or $CH_3 - CH = CH_2$
Butylene (Butene)	C_4H_8 or $CH_2 = CH - CH_2 - CH_3$
	or $CH_3 - CH_2 - CH = CH_2$

The boiling point and melting point of an alkene increase with increasing molecular mass.

11.22. Ethene or Ethylene (C_2H_4). Ethene is present in coal gas to the extent of 6% by volume. It also occurs in natural gas that issues out from oil-fields. It is also present in the gaseous mixture obtained by cracking of high boiling point oil fractions.

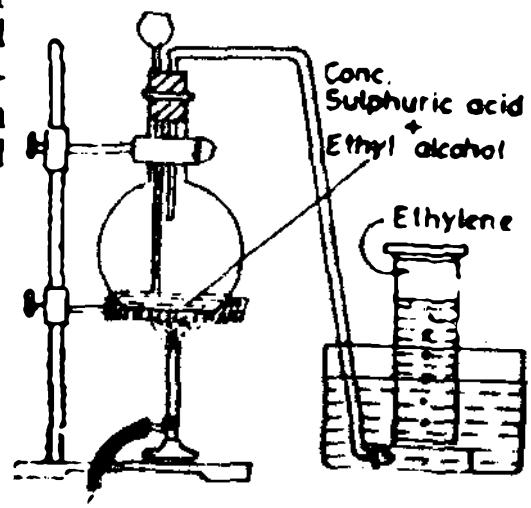
Preparation. Ethene is prepared by heating ethyl alcohol with conc. H_2SO_4 at 160–170°C.

$$C_2H_5OH + H_2SO_4 \xrightarrow{100°C} C_2H_5HSO_4 + H_2O$$

$$C_2H_5HSO_4 \xrightarrow{160° - 170°} C_2H_4 + H_2SO_4$$

ethylene

Take 25 ml of ethyl alcohol in a round bottom flask and mix with it about 50 ml of conc. sulphuric acid slowly and slowly. Add a little sand and anhydrous aluminium sulphate to the flask to prevent forthing. On heating the flask, ethylene gas is evolved and collected over water.



Preparation of Ethylene

Chemical Properties

(*i*) **Combustion.** Ethene burns in air with a sooty flame to form carbon dioxide and water.

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + H_2O + \text{Heat}$$

(*ii*) **Addition reactions.** In these reactions the double bond breaks up and two monovalent groups get attached to carbon atoms.

(*a*) **With bromine.** When bromine water is added to ethylene its red-brown colour is discharged.

$$CH_2 = CH_2 + Br \longrightarrow \underset{\text{Br}}{\overset{1}{CH_2}} - \underset{\text{Br}}{\overset{2}{CH_2}}$$

1, 2 dibromo methane

(b) **With hydrogen chloride.** Chloro methane is obtained.

$$H_2C = CH_2 + HCl \longrightarrow \underset{\text{chloro ethane}}{H_3C - CH_2Cl}$$

(*iii*) **Hydrogenation.** Hydrogen adds to ethene in presence of a nickel catalyst, to form ethane.

$$\underset{\text{ethene}}{CH_2 = CH_2} + H_2 \xrightarrow{Ni} \underset{\text{ethane}}{CH_3 - CH_3}$$

(*iv*) **Polymerisation.** Ethene undergoes addition reaction with itself. This reaction is called polymerisation. The product contains repeated chains of thousands of ethene molecules, and is known as polythene.

$$nH_2C = CH_2 \longrightarrow (CH_2 - CH_2)_n$$

11.23. Alkynes. A hydrocarbon in which two carbon atoms are connected by a triple bond is called an alkyne. The general formula of alkynes is C_nH_{2n-2} where n is the number of carbon atoms in one molecule. The names and molecular formulae of the five three alkynes are given below :

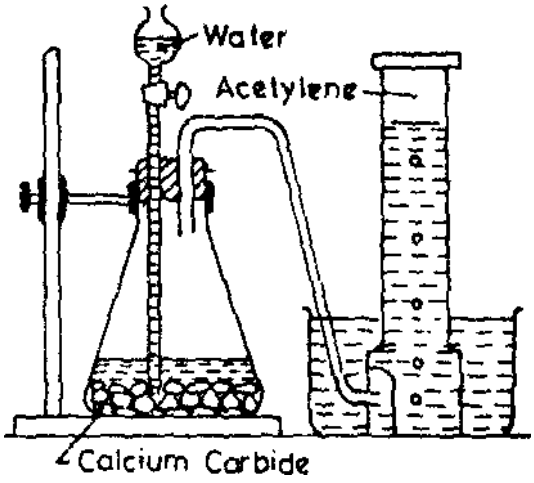
Name of alkyne	*Formula*
Ethyne (Acetylene)	C_2H_2 ($CH \equiv CH$)
Propyne	C_3H_4 ($CH_3C \equiv CH$)
Butyne	C_4H_6 ($CH_3CH_2C \equiv CH$)
Pentyne	C_5H_8 ($CH_3CH_2CH_2C \equiv CH$)
Hexyne	C_6H_{10} ($CH_3CH_2CH_2CH_2C \equiv CH$)

11.24. Ethyne (Acetylene). It does not occur freely in nature. Traces of acetylene are present in coal gas (about 0–.06%).

Preparation. Acetylene is prepared in the laboratory by the action of water on calcium carbide.

$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$

A few pieces of calcium carbide are taken in a conical flask. From the dropping funnel, water is poured dropwise on calcium carbide. Calcium carbide reacts with water to produce acetylene which is collected over water.



Preparation of Acetylene

Chemical Properties of Acetylene

(*i*) ***Combustion.*** *It* burns with a luminous flame giving carbon dioxide and water.

$$2HC \equiv CH + 5O_2 \longrightarrow 4CO_2 + 2H_2O$$

(ii) **Addition reactions.** In these reactions the triple bond breaks up and addition takes place at the carbon atoms.

(*a*) **Addition of hydrogen.** Ethyne adds on hydrogen in the presence of finely divided palladium, platinum or nickel to form ethene and finally ethane.

$$HC \equiv CH \xrightarrow[Ni/300°C]{H_2} \underset{\text{ethene}}{H_2C = CH_2} \xrightarrow[Ni/300°C]{H_2} \underset{\text{ethane}}{H_3C - CH_3}$$

(b) **Addition of halogens.** Ethyne adds two molecules of chlorine or bromine across the triple bond.

$$HC \equiv CH \xrightarrow{Br_2} BrHC{=}CHBr \xrightarrow{Br_2} \underset{\substack{| \quad | \\ Br \quad Br \\ \text{1, 1, 2, 2 tetra bromo} \\ \text{methane}}}{Br - CH - CH - Br}$$

It is due to the above reaction that bromine water gets decolourised when acetylene is bubbled through it. This is called bromine test for unsaturation.

(*c*) **Addition of HCl.**

$$\underset{\substack{\equiv \\ CH \\ \text{ethyne}}}{CH} \xrightarrow{HCl} \underset{\|}{CH_2} \xrightarrow{HCl} \underset{|}{CH_2}$$
$$\qquad\qquad\quad CHCl \qquad\quad CHCl_2$$

(*iii*) **Polymerization. When acetylene is passed through a dull red hot tube, it gives benzene.**

$$3C_2H_4 \xrightarrow{\text{Red hot tube}} \underset{\text{Benzene}}{C_6H_6}$$

(*iv*) With ammonical solutions of silver nitrate and cuprous chloride, acetylene gives precipitate of silver acetylide (white) and cuprous acetylide (red) respectively.

$$\begin{matrix} C\ H \\ \vert\vert\vert \\ C\ H \end{matrix} + 2AgNO_3 + 2NH_4OH \longrightarrow \underset{\text{silver acetylide (white ppt)}}{\begin{matrix} C\ Ag \\ \vert\vert\vert \\ C\ Ag \end{matrix}} + 2NH_4NO_3 + 2H_2O$$

$$\begin{matrix} C\ H \\ \vert\vert\vert \\ C\ H \end{matrix} + CuCl_2 + 2NH_4OH \longrightarrow \underset{\text{cuprous acetylide (red ppt)}}{\begin{matrix} C\ Cu \\ \vert\vert\vert \\ C\ Cu \end{matrix}} + NH_4Cl + H_2O$$

11.25. Petroleum and its Products. It is a mixture of hydrocarbons formed by the decomposition of animal and plant remains embedded in burried sedimentary layers. This is called crude petroleum.

11.26. Occurrence of petroleum. Petroleum occurs deep down under the earth between two layers of impervious rocks.

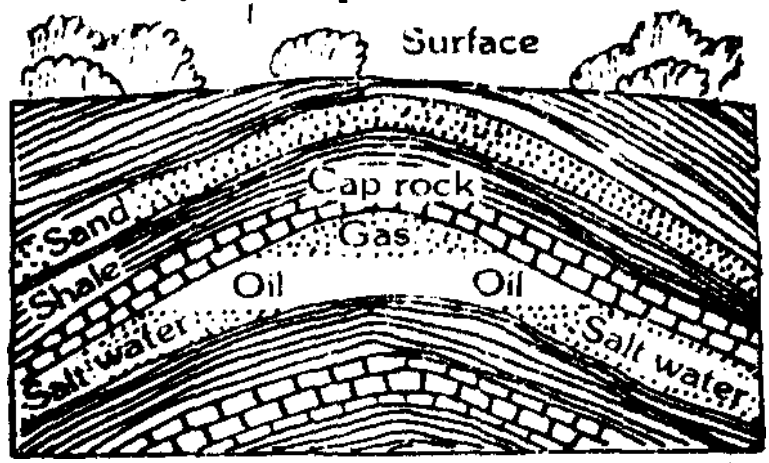


Fig. Occurrence of Petroleum under rocks

11.27. Production of petroleum. Petroleum obtained by drilling holes (oil wells) into the earth's crust. Some of the places in our country where oil is being produced are : Ankleshwar and Kalol in Gujarat, Rudrasagar in Assam, and Bombay High (off-shore area).

Refining of petroleum. The process of separating crude petroleum into more useful fractions by fractional distillation is known as refining of petroleum.

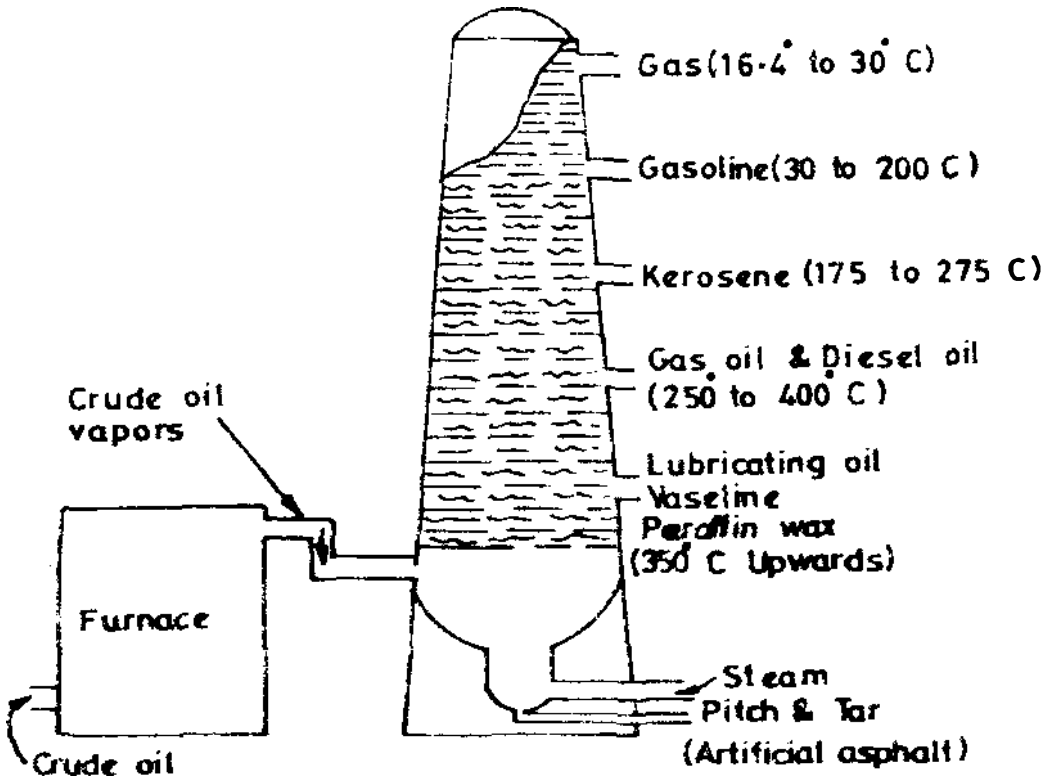


Fig. Fractional Distillation of Crude Oil.

11.28. Fractions from refining of petroleum and their uses

Sl. No.	*Name of the fraction*	*Boiling point range of constituents*	*Molecular Composition*	*Uses*
1.	Uncondensed gases.	–164°C–30°C	C_1–C_7	Gaseous fuel, production of carbon black, hydrogen, or gasoline.
2.	Gasoline	30°C–200°C	C_5–C_{12}	Motor fuel, solvent drycleaning making petrol gas.
3.	Kerosene	195°C–275°C	C_{12} to C_{16}	Household fuel for heating and lighting, making oil gas.

4.	Gas oil and *diesel oil*	250°C–400°C	C_{15} to C_{18}	Furnace oil, fuel for diesel engines cracking.
5.	Lubricating oil, vaseline paraffin wax	350°C and above	C_{16} upward	Lubrication, vaseline grease, wax for candle manufacture

11.29. Simple compounds of carbon, hydrogen and oxygen

Alcohols. An alcohol is produced on replacement of one hydrogen atom of an alkane by a hydroxyl (– OH) group. The general formula of the homologous atom series of alcohols is $C_nH_{2n+1}OH$. They are named after the parent alkane by replacing the last letter *e* by *ol*. The names, formulae of the homologues of methol are given :

Formula of the alcohol $C_nH_{2n+1}OH$	*Corresponding alkane* C_nH_{2n+2}	*Common name alcohol*	*I.U.P.A.C. name alcohol*
CH_3OH (n = 1)	CH_4 Methane	Methyl alcohol	Methanol
C_2H_5OH (n = 2) or CH_3CH_2OH	C_2H_6 Ethane	Ethyl alcohol	Ethanol
C_3H_7OH (n = 3) or $CH_3CH_2CH_2OH$	C_3H_8 Propane	Propyl alcohol	Propanol
C_4H_9OH (n = 4) or $CH_3CH_2CH_2CH_2OH$	C_4H_{10} Butane	Butyl Alcohol	Butanol

Most common alcohols are liquids. They react with sodium to form hydrogen.

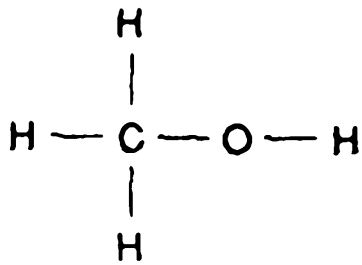
$$2CH_3OH + 2Na \longrightarrow 2CH_3ONa + H_2$$

$$2C_2H_5OH + 2Na \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + H_2$$

Like hydrocarbons, they do not conduct electricity.

11.30. Methanol. Molecular formula : CH_3OH .

Structural formula :



It is also known as methyl alcohol, carbinol, wood spirit and wood naphtha.

Industrial preparation of methanol. Methyl alcohol is prepared on large scale by the partial oxidation of methane obtained from natural gas. Methane is mixed with oxygen and passed through copper tubes (catalyst) under a pressure of 100 atmospheres at 473 K – 573 K.

$$\underset{\text{methane}}{CH_4} + \tfrac{1}{2}O_2 \xrightarrow[473-573\ K]{100\ atm} \underset{\text{methanol}}{CH_3OH}$$

Methanol is now largely synthesised from water gas ($CO + H_2$) which is obtained by the action of steam on red hot coke.

$$C(s) + H_2O(g) \xrightarrow{Heat} \underset{\text{water gas}}{CO + H_2}$$

Water gas (1 volume) is mixed with hydrogen (half the volume of water gas) and mixture is purified first from arsenic, sulphur and phosphorus compounds. The mixture is then compressed to about 200 atmospheric pressure and introduced into a chamber containing zinc oxide and chromic oxide (catalyst). The chamber is heated by electric coils at a temperature of about 573 K. Methyl alcohol so obtained gets condensed in the condenser and collected.

It can also be obtained from pyroligneous acid fraction of destructive distillation of wood.

Physical properties of methanol

(*i*) It is a colourless volatile liquid.

(*ii*) It is miscible with water, ether and acetone in all proportions.

(*iii*) It burns with a blue flame.

(*iv*) Pure methanol boils at 60°C.

Uses of methanol

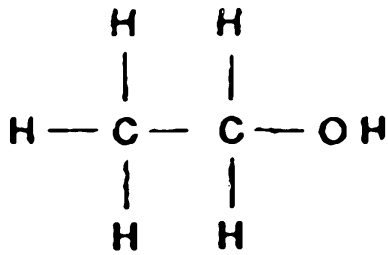
(*i*) It is used as a solvent for fats, oils, gums, shellac, celluloid, paints and varnishes.

(*ii*) It is also used to denature industrial alcohol.
(*iii*) Methanol is used as antifreeze for automobile radiators and as a component of motor spirit blends.
(*iv*) It is used in the manufacture of formaldehyde.

11.31. Ethanol or Ethyl Alcohol

Molecular formula : C_2H_5OH

Structural formula :



Ethyl alcohol is simply called as alcohol or grain alcohol.

Industrial preparation of ethyl alcohol

Ethyl alcohol is a product of fermentation. The process of decomposition of organic substances by the action of bacteria, yeast or their enzymes is called fermentation. Souring of milk is due to fermentation. Ethyl alcohol is manufactured by the fermentation of maltose which is obtained from the starch in grains.

$$\text{Starch} + \text{Water} \xrightarrow{\text{Diastase}} \text{Maltose}$$

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Maltose}} \underset{\text{Glucose}}{2C_6H_{12}O_6}$$

$$C_6H_{12}O_6 \xrightarrow{\text{Enzyme in yeast}} \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + 2CO_2\,(g)$$

Fermentation of starch. Barley or wheat grains are smashed and treated with hot water and then filtered to extract a solution of starch. This starch solution is heated to about 55°C with malt. Malt is germinated barley which contains a mixture of enzymes known as diastase. The starch is hydrolysed to maltose by enzymes. This liquid is cooled to 35°C and yeast which contains maltase is added so that maltose is hydrolysed to glucose. The zymase also present in the yeast catalyses the decomposition of glucose to ethyl alcohol and carbon dioxide. The fermented liquid contains upto 10 per cent ethyl alcohol and is used as bear. Pure alcohol is obtained by distillation of fermented liquid.

Ethyl alcohol from molasses. In India most of the ethyl alcohol is obtained from molasses. Molasses is a black colour thick syrupy mass left as mother liquor after the crystallisation of cane sugar from concentrated cane juice. Molasses still contains about 60 per cent fermentable sugar.

Molasses is diluted with water by mixing the two in the ratio 1 : 5 by volume. A small amount of ammonium sulphate or ammonium phosphate is added as the food for yeast. A small amount of sulphuric or ammonium phosphate is added as the food for yeast. A small amount of sulphuric acid is added to check and yeast is added to it. The mixture is maintained at about 30°C for 2 or 3 days. The enzymes invertase and zymase present in the yeast bringing about conversion of sugar into ethyl alcohol and carbon dioxide.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{glucose}}{C_6H_{12}O_6} \xrightarrow{\text{Zymase}} \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + \underset{\text{carbon dioxide}}{2CO_2}$$

The fermented liquid known as wash contains about 18% ethyl alcohol. Pure alcohol is obtained by the process of distillation.

Ethyl alcohol from ethene. Ethanol is manufactured by passing a mixture of ethene and steam over the catalyst (phosphoric acid on silica) at 300°C and a pressure of 70 atmosphere. The unreacted mixture is circulated again and again over the catalyst to get a good yield of ethanol.

$$\underset{\text{ethane}}{H_2C = CH_2} + \underset{\text{steam}}{H_2O} \xrightarrow[\text{on silica 300°C 70 atm}]{\text{phosphoric acid}} \underset{\text{ethanol}}{CH_3CH_2OH}$$

Physical properties of ethyl alcohol

1. It is colourless volatile liquid with a pungent taste. It has a peculiar smell.
2. It is miscible with water, ether, acetone in all proportions.
3. It burns with colourless flame.
4. Pure ethyl alcohol boils at 78°C.

Chemical properties

(*i*) **With sodium.** Ethyl alcohol reacts with sodium to form sodium ethoxide and hydrogen gas

$$2C_2H_5OH + 2Na \longrightarrow \underset{\text{sodium ethoxide}}{2C_2H_5ONa} + H_2$$

(*ii*) **Oxidation.**

(*a*) **Mild oxidation.** When ethyl alcohol is heated with cupric oxide, its partial oxidation takes place and acetaldehyde is formed.

$$C_2H_5OH + CuO \longrightarrow \underset{\text{Acetaldehyde}}{CH_3CHO} + Cu + H_2O$$

(*b*) **Strong oxidation.** When ethyl alcohol is heated with a mixture of potassium dichromate and dilute sulphuric acid, its complete oxidation takes place and acetic acid is formed.

$$C_2H_5OH + 2[O] \xrightarrow{K_2Cr_2O_7 + H_2SO_4} \underset{\text{Acetic acid}}{CH_3COOH} + H_2O$$

(*iii*) **Formation of esters.** Ethanol reacts with acetic acid in presence of an acid (usually H_2SO_4) ethyl acetate is formed.

$$CH_3COOH + C_2H_5OH \underset{}{\overset{\text{con. } H_2SO_4}{\rightleftharpoons}} \underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H_2O$$

(*iv*) Ethanol burns in air with a blue frame to form carbon dioxide and water.

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

(*v*) **Action of PCl_5**

$$C_2H_5OH + PCl_5 \longrightarrow C_2H_5Cl + POCl_3 + HCl$$

11.32. Organo acids. Organic acids contain the COOH group known as the carboxylic acid group. The acids are named after the respective alkane containing the same number of carbon atoms, by substituting the last letter *e* of the corresponding alkane by *oic acid*. The formulae and names of the first four members of the homologous acids are given below :

Alkanoic Acids

Formulae	*Name*	*Common name*
HCOOH	Methanoic acid	Formic acid
CH_3COOH	Ethanoic acid	Acetic acid
C_2H_5COOH	Propanoic acid	Propanoic acid
C_3H_7COOH	Butanoic acid	Butyric acid

These acids occur in a liquid form. Acids whose molecules contain a large number of carbon atoms ($n > 16$) occur as solids. They are used as mild acids, in foods, cold drinks, drugs, perfumes and soaps.

11.33. Acetic acid (CH_3COOH). Acetic acid is obtained by the oxidation of ethyl alcohol with acidified $K_2Cr_2O_7$ solution.

$$CH_3CH_2OH \xrightarrow{O} \underset{\text{Acetaldehyde}}{CH_3CHO} \xrightarrow{O} \underset{\text{Acetic acid}}{CH_3COOH}$$

Properties

(*i*) It is a colourless liquid having a sour taste.

(*ii*) The boiling point of acetic acid is 118°C.

(*iii*) It is miscible with water in all proportions.

Chemical properties

(*i*) **With sodium bicarbonate.** Acetic acid reacts with sodium bicarbonate to evolve carbon dioxide gas with effervescence.

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$$

(*ii*) **Reaction with alcohol.** When acetic acid is warmed with ethyl alcohol in presence of a few drops of conc. H_2SO_4, ethyl acetate is formed

$$CH_3COOH + C_2H_5OH \xrightarrow{\text{con. } H_2SO_4} \underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H_2O$$

Uses of Acetic acid

(*i*) Dilute acid is used as vinegar for table purposes.

(*ii*) It is used for making cellulose acetate which is an important artificial fibre.

(*iii*) It is used for preparing esters.

(*iv*) It is used to coagulate rubber from the latex.

11.34. Esters. Compounds which contain the functional group COO are called esters.

Esters are formed when organic acids react with alcohols in the presence of sulphuric acid.

$$CH_3COOH + C_2H_5OH \xrightarrow{\text{catalyst } (H_2SO_4)} \underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H_2O$$

Esters have fruity smell. They are used in cold drinks, ice creams, sweets and perfumes. They are also found to occur in fruits.

11.35. Sources of Carbon compounds. The main sources of organic compounds are (*i*) plants and animals (*ii*) coal (*iii*) petroleum.

(*i*) Plants provide the maximum number of organic compounds such as vegetable oil, essential oils, starch, cellulose, sugar, drugs, dyes, alkaloids, insecticides etc. animal tissue gives us fats and oils.

(*ii*) The organic compounds obtained from coal are : benzene, toluene, phenol, naphthalene and anthracene.

(*iii*) Petroleum gives us petrol, kerosene, diesel, lubricating oils, vaseline and other petro-chemicals.

11.36. Man made materials

(*i*) **Synthetic Fibres.** Synthetic fibres are polymers comprised of one or more units (assemblage of atoms in a definite pattern) repeating themselves to form very large molecules. Poly means many and mer means a repeating unit. Cellulose is a naturally occurring polymer. The walls of all plant cells are made of cellulose. Wood contains a large amount of this natural polymer. Paper is a purified form of cellulose. It is made from wood, grains and other cellulose molecules. Cotton and jute are natural fibres made of cellulose.

(*ii*) **Rayon.** Rayon is a man-made material which consists of purified cellulose in the form of long fibres. It is made from paper strips dipped in cold sodium hydroxide solution to further purify the cellulose and then treated with carbon disulphide to form a cellulose solution. This solution is allowed to pass through fine pores in metal cylinders, into a dilute solution of sulphuric acid. This results in the formation of long fibre cellulose known as viscous rayon. Rayon fibre is chemically identical to cotton but has a shine like silk.

Uses of Rayon

(*i*) *In textile industry.* Rayon is used in the manufacture of textiles like sarees. Rayon mixed with cotton (50–50) is used for making nurses dresses aprons, and caps. Rayon mixed with wool in equal quantities is used in the manufacture of carpets.

(*ii*) Rayon is used for the manufacture of tyre cord.

(*iii*) It is used for making gauze and lint used in medical field.

(*iii*) **Nylon.** Nylon was the first synthetic fibre made by man.

Preparation. Nylon is made by condensing adipic acid with hexamethulene diamine.

$$\underset{\text{Adipic acid}}{HCOOC-(CH_2)_4-COOH} + \underset{\text{Hexa methylene diamine}}{H_2N-(CH_2)_6-NH_2} \longrightarrow$$

$$HCOOC-\underset{\substack{\text{nylon}\\(\text{A polyamide})}}{[-(CH_2)_4-CO-NH-(CH_2)_6-]}-NH_2 + nH_2O$$

Uses of Nylon

(i) Nylon thread is of great strength, therefore, it is used for making cords, fishing nets, parachute fabric, climbing ropes and bristles of tooth brushes.

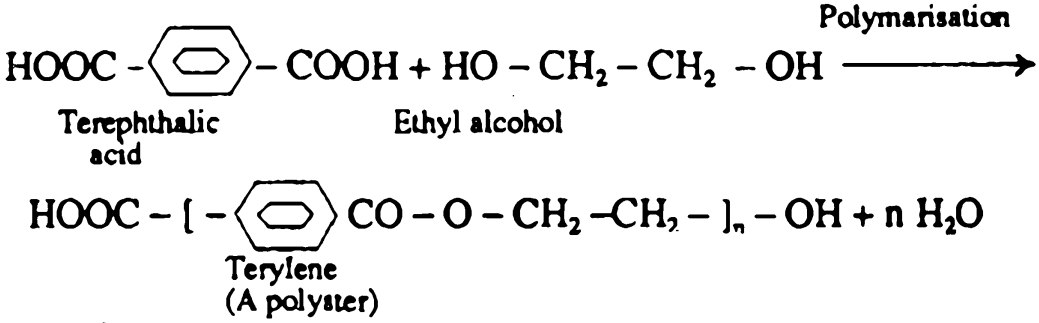
(*ii*) Nylon ropes are very light, strong and flexible. Therefore nylon climbing ropes are prepared.

(*iii*) Nylon is used in the production of textiles like sarees, shirts, neckties, socks and other garments.

(*iv*) Nylon is blended with wool to increase their strength and resistance to wear and tear, wool blended with nylon (75% wool and 25% nylon) is used to make socks and suits.

(*iv*) **Polyester**

Preparation. It is made by reacting a carbon compound with two hydroxyl (– OH) groups with a compound containing two carboxylic acid groups (– COOH). The reaction between the hydroxyl and carboxylic acid group results in the formation of an ester group (– COO –). since this fibre contains many ester groups, it is called polyester.



Properties

(*i*) Polyester fibres absorb very little water. Clothes made of polyester, therefore, dry quickly after washing.

(*ii*) The fibre retains crease and lasts for a long time.

Uses of Polyester

(*i*) It is used in the manufacture of textiles – Sarees, dress material and curtains.

(*ii*) It is used for making sails for sail boats, and variety of other materials such as water hoses for fire fighting.

(*v*) **Carbon Fibres.** Carbon fibres made of long chains of carbon atoms possess high strength and are resistant to corrosion.

They are made from regenerated or synthetic fibres by heating them in the absence of oxygen. There upon the fibres decompose to produce carbon fibres.

Uses of Carbon Fibres

(*i*) Carbon fibres are used in space craft.

(*ii*) These fibres are used for making sports goods.

11.37. Plastic. Plastics are materials which can be easily moulded or set into a desired shape. Examples of plastics are bakelite, nylon, terelene, polythene etc. Plastics are of two types : thermoplastics and thermosetting.

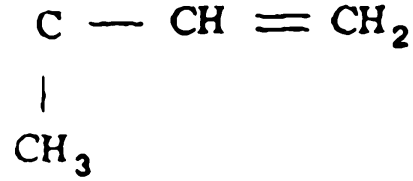
A plastic substance which can be melted repeatedly by heating and can be moulded again and again into different shapes is called a thermoplastic polymer.

Examples of thermoplastic substances are: polythene, nylon, terylene, polyvinyl chloride (PVC) and polystyrene.

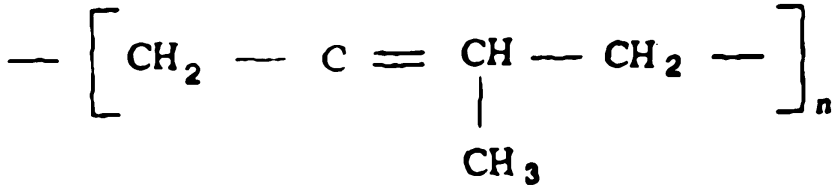
A plastic substance which does not soften much on heating and can not be moulded a second time is called a thermosetting plastic. Two examples of thermosetting polymers are : phenol-formaldehyde (bakelite) and melamine-formaldehyde (melamine).

Thermoplastics contain long chains of polymers. However, thermosetting polymers which also contain long chains, are cross linked with each other. The linkages prevent the displacement of individual chains on being heated. Thus, thermosetting plastics do not suffer change in shape once they have been set.

11.38. Rubber. Natural rubber is a linear polymer of isoprene.



There may be as many as 11,000 to 20,000 isoprene units in a polymer chain of natural rubber. Therefore, the natural rubber can be represented as



natural rubber

Properties of Natural Rubber

(*i*) The natural rubber is a soft and sticky solid.

(*ii*) It is insoluble in water, alcohol, acetone, dilute acids and alkalies, but soluble in ether, carbon disulphide, carbon tetrachloride etc.

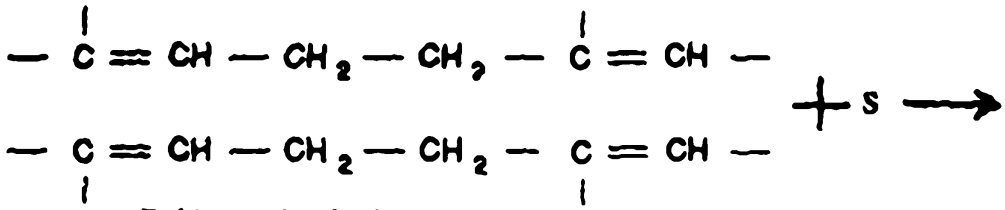
(*iii*) Natural rubber is elastic. The elasticity of rubber is due to its coil like structure.

(*iv*) It has a low tensile strength *i.e.* it is not strong.

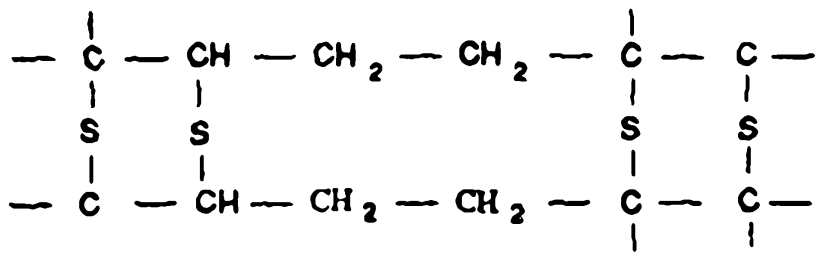
(*v*) It has low abrasion resistance *i.e.* low wear and tear resistance.

(*vi*) It absorbs a large amount of water.

11.39. Vulcanisation of natural rubber. The process of heating natural rubber with sulphur to improve its properties is called vulcanization. Sulphur combines with chains of rubber molecules forming cross links between them.



Rubber molecules before vulcanization

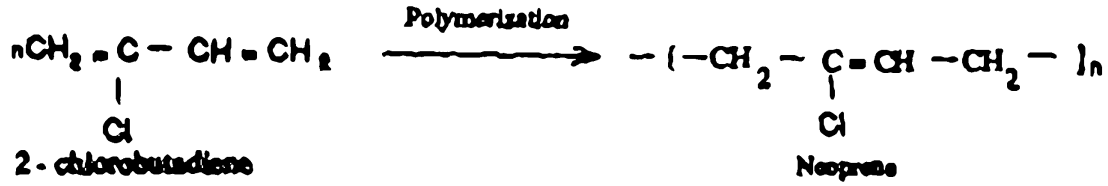


Rubber molecules after vulcanization

These cross-links prevent slipping of the hydrocarbon chains and serve to pull them back to their normal curled up state on the removal of the stretching force. Hence vulcanization improves the tensile strength and elasticity of rubber due to the cross-linking between carbon atoms.

11.40. Synthetic Rubber

Neoprene. Neoprene is a synthetic rubber. It is made from 2–chloro butadiene by polymerisation.



2 - chlorobutadiene — Neoprene

11.41. Properties of Neoprene

(*i*) It does not burn readily like natural rubber. It is due to the presence of a large number of chlorine atoms that neoprene does not catch fire easily.

(*ii*) It is comparatively less affected by oils and solvents.

(*iii*) It is stable at higher temperature

(*iv*) It is not attacked by oxygen or ozone.

11.42. Thiokol. It is a synthetic rubber. It is made by reacting dichloro ethane with sodium poly sulphide.

$$n[Cl - CH_2 - CH_2 - Cl] + n[Na - S - S - Na] \longrightarrow Cl - [CH_2 - CH_2 - S - S - CH_2 - CH_2]_n Cl$$

Properties of Thiokol

(*i*) It is resistance to oils and solvents.

(*ii*) It is resistant to the action of oxygen and ozone.

Uses of Thiokol

(*i*) It is used for making hoses and linings of vessels used in the manufacture of chemicals, as well as storage tanks.

(*ii*) It is used as a solid fuel in rocket engines.

11.43. Soaps and Detergents. Soap – Soaps are sodium salts of long chain fatty acids. Soaps are soluble in water and are used for washing and cleansing purposes. The common soaps are those of sodium and potassium salts of fatty acids. Sodium salts are hard soaps whereas potassium soaps are soft.

When oil or fats are heated with a solution of sodium hydroxide, they breakdown to form sodium salt of the respective fatty acid and glycerol.

$$\begin{array}{lll} C_{15}H_{31}COO-CH_2 & & CH_2OH \\ \quad\quad | & & \quad | \\ C_{15}H_{31}COO-CH & + 3NaOH \longrightarrow & CHOH \quad + 3C_{15}H_{31}COONa \\ \quad\quad | & & \quad | \qquad\qquad\quad \text{(soap)} \\ C_{15}H_{31}COO-CH_2 & & CH_2OH \\ & & \text{Glycerol} \end{array}$$

The process of splitting the fat is called saponification. It produces soap, which is separated from the solution by the addition of common salt. Salt decreases the solubility of soap which is therefore released from the solution and being lighter floats on it. Soap is then just skimmed off. The solution remaining behind contains glycerol and sodium chloride. The soap which is thus separated is then mixed with a desired colouring agent and perfume and cast into various shapes for our use.

11.44. Cleansing Action of Soap. A molecule of soap can be considered to be made up of two components. One part is a hydrocarbon and the other belongs to the – COONa group. Hydrocarbons are water repelling (hydrophillic). Dirt and grease attach themselves to the hydrocarbon component of the soap molecule. The – COONa part which is attached to water molecules pulls the dirt away from the surface, thereby washing it clean.

When soap is dissolved in water it forms micelles. In a micelle, the soap molecules are arranged radially, with the hydrocarbon and directed towards the centre and the water attracting part outwards. The dirt and grease particles lying on the surface wetted by soap are thus entrapped by these micelles and removed.

11.45. Synthetic Detergents. They contain a two headed molecule one end of which is water repelling and the other water attracting. Detergents are made from hydrocarbons obtained from coal or petroleum. The hydrocarbon molecules act as the water repelling end, while the water attracting part is usually constituted by a sulphate ($-SO_4Na$) or a sulphonate ($-SO_3Na$) group.

Synthetic detergents can lather well even in hard water as unlike soaps, they do not form insoluble calcium or magnesium salts with hard water.

Washing powders contain only about 15–30% detergents by weight. The rest is made up of other chemicals added to impart its desired properties. Sodium sulphate and sodium silicate are added to keep the washing powder dry. Sodium tripolyphosphate or sodium carbonate is added to maintain alkalinity which is helpful in removing dirt. Carboxymethyl cellulose (CMC) is added to keep the dirt suspended in water. A mild bleaching agent such as sodium perborate is also added to produce whiteness.

TEXT-BOOK QUESTIONS

Q. 1. What are allotropes of an element ? What is allotropy ? Name two allotropes of carbon.

Ans. Elements which differ markedly in their physical properties but are chemically identical are called allotropes. This phenomenon is called allotropy.

Examples. Carbon, phosphorus, sulphur show allotropy. Diamond and graphite are the two allotropes of carbon.

Q. 2. Explain how the electrical conductivity of diamond and graphite are so widely different ?

Ans. In diamond each carbon atom lies at the centre of a regular tretrahedron and is covalently bonded with four carbon atoms located at its four corners. All bonding electrons of the carbon atom are thus engaged leaving no free electrons. This makes diamond an extremely poor conductor of electricity.

Each carbon atom in graphite is covalently bonded to only three neighbour carbon atoms. Thus only the three valency electrons of each carbon atom in graphite are used in bond formation. The fourth valence electron of each carbon atom is 'free'. This enables an easy flow of electrons through graphite and makes it a good conductor of electricity.

Q. 3. (a) Why is graphite used as a lubricant ?

(b) Why is diamond used for cutting tools ?

Ans. (*a*) Graphite is used as a lubricant because it is soft and slippery.

It is suitable in machines where high temperature makes other lubricants unsuitable because it has high melting point.

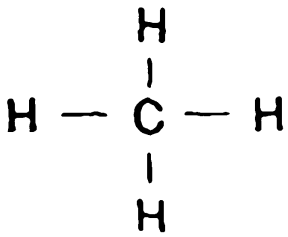
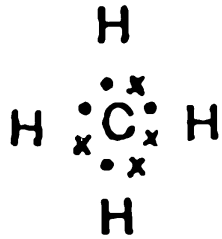
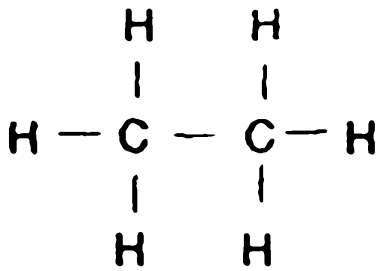
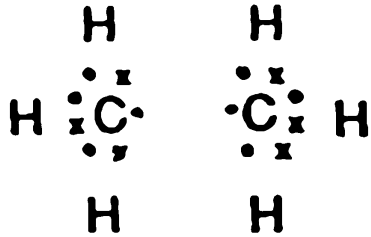
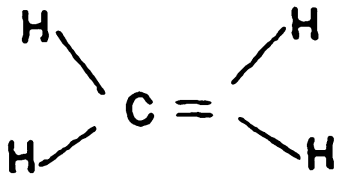
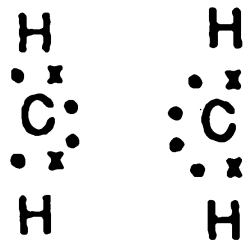
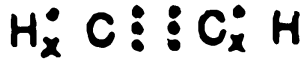
(*b*) Diamond is used for cutting tools because it is the hardest substance known.

Q. 4. What will happen if a piece of diamond is dropped in a charcoal fire ?

Ans. When a piece of diamond is dropped in a charcoal fire, it burns in air at 900°C forming carbon oxide and leaving a trace of ash about 0.5% consisting of silica and iron oxide.

Q. 5. Write down the structural and electronic formulae of methane, ethane, ethene and ethyne.

Ans.

	Structural formula	*Electronic fromula*
Methane		
Ethane		
Ethene		
Ethyne		

Q. 6. Name three different sources of methane.

Ans. Sources of methane

(*i*) Natural gas contains about 90% methane.

(*ii*) Coal gas contains about 30% methane.

(*iii*) Sewage sludge which has been fermented by bacteria yields a gas containing 70% methane.

Q. 7. Write the molecular formula of an alkane and an alkene with twenty carbon atoms.

Ans. Molecular formula of alkane with twenty carbon atoms is $C_{20}H_{42}$. Molecular formula fo alkene with twenty carbon atoms is $C_{20}H_{40}$.

Q. 8. You are given samples of alkane and an alkene. How will you differentiate between them ?

Ans. 1. **Bromine water test.** Add bromine water to each of them separately. The sample, which decolourises bromine water, contains alkene and the other sample, which does not react with bromine water, is an alkane.

2. **Bayer's Reagent Test.** Add alkaline potassium permanganate solution to each of them separately. The sample, which discharges the purple colour of $KMnO_4$, is an alkene and other sample, which does not react with alkaline $KMnO_4$, is an alkane.

Q. 9. How will you prepare methane gas in the laboratory ?

Ans. Please see art 11.14.

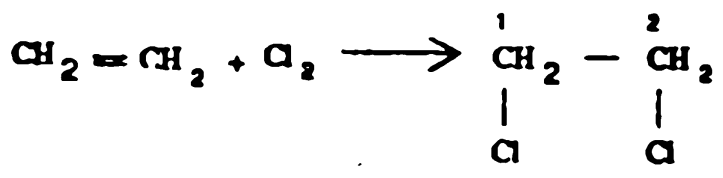
Q. 10. Draw the structural formulae of the two isomers of butane.

Ans. Please see art 11.17.

Q. 11. What are addition reactions ? Give an example.

Ans. Addition reactions. The reaction in which an unsaturated hydrocarbon combines with another substance to give a single product is called an addition reaction. Addition reactions are the characteristic property of unsaturated hydrocarbons. Addition reactions are given by all unsaturated hydrocarbons containing a double or a triple bond.

Example. Addition reaction of ethylene with chlorine.



1, 2 dichloro ethane

Q. 12. What is cracking of alkane ? Illustrate with an example.

Ans. Cracking. Cracking is a process of breaking down certain large (high molecular mass) hydrocarbons into smaller ones of lower boiling points

as by excess heat at high temperature. (Thermal cracking) or at low temperature in presence of a catalyst like alumina or silica. The products of cracking of alkanes depend upon the following factors :

(*i*) structure of the alkane,

(*ii*) the pressure employed

(*iii*) the presence or absence of catalysts.

$$C_{16}H_{34} \longrightarrow C_8H_{20} + C_8H_{18}$$

$$C_8H_{18} \longrightarrow CH_3CH_2CH_2CH_3 + CH_3CH = CHCH_3$$

$$C_{15}H_{36} \longrightarrow C_8H_{18} + C_7H_{18}$$

Q. 13. How is ethanol manufactured commercially ? Name two uses of ethanol.

Ans. Please see art. 11.31.

Uses

1. It is used to sterilise wounds and syringes.
2. It is constituent of beer, wine, whisky and other liquors. It is used in cough syrups, tonics and other medicines also.

Q. 14. Write molecular formula of ethanoic acid, butanol and ethyne.

Ans.

	Structural formula	*Molecular formula*
Ethanoic acid	CH_3COOH	$C_2H_4O_2$
Butanol	$CH_3CH_2CH_2CH_2OH$	$C_4H_{10}O$
Ethyne	$HC \equiv CH$	C_2H_2

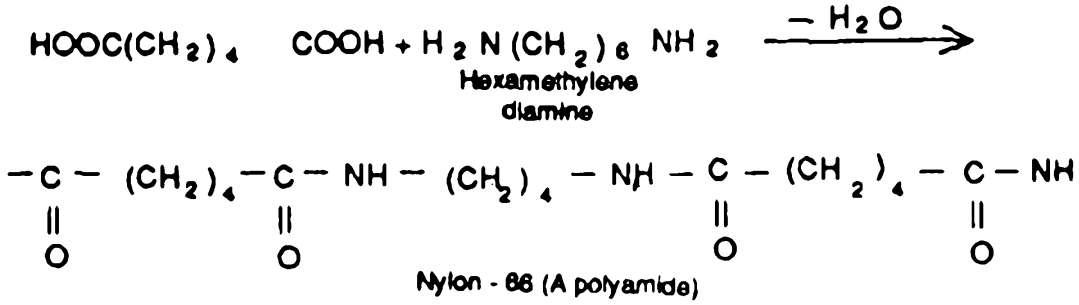
Q. 15. What is rayon ? How it is made ? What are its important uses ? Why is rayon called a regenerated fibre ?

Ans. Rayon is a man-made material which consists of purified cellulose in the form of long fibres. It is made from paper strips dipped in cold sodium hydroxide solution to further purify the cellulose and then treated with carbon disulphide to form a cellulose solution. This solution is allowed to pass through fine pores in metal cylinders, into a dilute solution of sulphuric acid. This results in the formation of long fibre cellulose known as viscose rayon. Rayon fibre is chemically identical to cotton but has a shine like silk. Because it is derived from a renewable source, it is called a regenerated fibre. Rayon is used on a large scale in India for making textiles, tyrecord, carpets and surgical dressings.

Q. 16. Give a brief description of the polyamide fibre. Name two naturally occurring polyamide fibres.

Ans. The polymers containing repeating amide (– NH–CO –) groups are called polyamides. A carbon compound with two amine (– NH_2) groups

is reacted with another carbon compound containing two carboxylic acid (– COOH) groups, *e.g.*



Silk and wool are two naturally occurring polyamide fibres.

Q. 17. Why have synthetic fibres become so popular ?

Ans. Synthetic fibres have become so popular for their following properties :

(*i*) These fibres are very strong.

(*ii*) Synthetic fibres are fairly elastic.

(*iii*) These fibres absorb very little of water. Due to this a wet cloth of synthetic fibre dries out rapidly.

(*iv*) Synthetic fibre clothes do not get crumpled easily during washing or wear. They resist wrinkles and keep permanent creases.

(*v*) These fibres have high resistance to abrasion (wear and tear).

(*iv*) **Moth resistant.** Synthetic fibres are not attacked by moth, mildew and mould.

(*vii*) Synthetic fibres are light-weight. Natural fibres are comparatively heavy.

Q. 18. What are thermoplastics ? Give two examples of thermoplastics.

Ans. Those plastics, which become soft on heating, are called 'thermoplastics'. This property allows them to be set in a desired shape which is retained on cooling.

Examples of thermoplastics are polyvinyl chloride (PVC) and polystyrene.

Q. 19. What are thermosetting plastics ? Give two examples of thermosetting plastics.

Ans. Those plastics which once set in a given shape by heating cannot be softened or melted on being heated. These irreversible polymers are called 'thermosetting plastics'.

Two examples of thermosetting plastics are phenol-formaldehyde resin (bakelite) and malamine-formaldehyde (melamine).

Q. 20. How is vulcanized rubber different from natural rubber ?
Ans. Comparison of properties of natural and vulcanized rubber

	Property	*Natural rubber*	*Vulcanized rubber*
1.	Nature	Soft and sticky	Hard and non-sticky
2.	Tensile strength	Low, 300 pounds per sq. inch	Very high, 3000 pounds per sq. inch
3.	Abrasion resistance	Low	High
4.	Temperature range for use	10 to 60°	– 40 to 100°C
5.	Elasticity *i.e.* Rapidity of retraction	Good	Very good
6.	Water absorption	Large	Small
7.	Solubility	Soluble in solvents like carbon disulphide, chloroform, turpentine etc.	Insoluble in all these solvents.

Q. 21. How will you make soap ?

Ans. Take about 50 ml of oil (cotton seed, linseed oil) in a beaker. Add 50 mil of 40% sodium hydroxide to it. Boil the mixture till a thick paste is produced. Add some quantity of filler and some quantity of sodium chloride to the mixture. The precipitate will settle down. This precipitate or paste is used as soap.

Q. 22. Why have detergents replaced soap as a washing agents ?

Ans. Detergents have replaced soap as a washing agents for the following reasons :

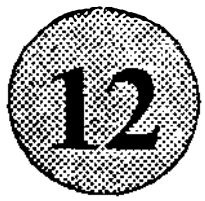
(*i*) Detergent solutions are neutral in nature. Therefore may be used for cotton as well as woollen clothes.

(*ii*) Detergents have more cleansing action.

(*iii*) Detergents can be used in soft as well as hard water.

Q. 23. What is the basic structure of a detergent ?

Ans. detergent is the sodium salt of a long chain benzene sulphonic acid or the sodium salt of a long chain alkyl hydrogen sulphate. A synthetic detergent has a large non-ionic hydrocarbon group and an ionic group like $SO_3^-Na^+$ or $OSO_3^-Na^+$.



BIOSPHERE

12.1. Population. The association of individual members of the same species living together in a particular locality is called a population. A population is a geographically localised group of individuals of the same species; individual members are capable of interbreeding within the group. This is called a biological population.

12.2. Two different factors of the environment. The environment of any population consists of two components.

1. The living or the biotic components.
2. The physical or the abiotic components.

All plants and animals in the surroundings of an organism constitute the biotic environment. Everything that is not alive in the surroundings like soil, water and solar radiation constitutes the abiotic environment.

12.3. Community. No population can exist in isolation. In any environment, a population is associated with several different populations of plants and animals.

This association of several populations of different species in a particular locality is known as a community. It is often referred as biotic community.

12.4. Different kinds of community. The association of different kinds of plants and animals in a pond constitutes the pond community. The different kinds of organisms living together in a meadow constitute the meadow community. Likewise, those living in a forest constitute the forest community. Even a large number of organisms living in a fallen log constitute a biotic community.

12.5. Ecosystem. a community exists in an abiotic environment. The relationship between a biotic community and an abiotic environment is expressed by the term ecosystem. A pond, a meadow, a forest, all are examples of ecosystems; even a small aquarium represents an ecosystem.

12.6. Structural components of an ecosystem. An ecosystem consists of a non-living environment and a living biological community.

The non-living environment of the ecosystems includes the basic organic and inorganic components of the physical environment like water, carbon dioxide, oxygen, nitrogen, phosphorus and other elements.

12.7. Different communities have some kind of interaction among themselves. The communities continuously interact among themselves and also with their physical environment. For example, you in your home interact with members of your family. You also interact with neighbours and in school with your classmates, other friends and teachers. Similarly you have some relationships with other animals and plants in your surroundings. You also interact with your physical environment.

12.8. Non-living components of biosphere. The non-living components of the biosphere consist of matter or substances such as air, water, soil and minerals. The factors such as light, temperature, humidity and pressure constitute climatic conditions. The climate along with nature of soil and water in an area determine the type of organisms found in the area.

12.9. Autotrophs. These organisms are capable of preparing their own food from simple raw materials like CO_2, H_2O in their green parts in the presence of sunlight. The green plants are autotrophs.

12.10. Heterotrophs. These organisms are not capable of preparing their own food in the absence of chloroplast. These organisms feed either on plants or on the flesh of other animals.

12.11. Decomposers. These are micro-organisms which are either saprophytic or parasitic in their mode of feeding. Bacteria and fungi live on dead decaying organic substances.

12.12. Planktons. Passively floating or drifting organisms are collectively termed as plankton. A plankton is composed of mostly microscopic plants (phytoplanktons) and animals (zooplanktons). The phytoplanktons are microscopic, free floating aquatic plants whereas zooplanktons are microscopic free floating animals.

12.13. Basic law of ecology. The laws of thermodynamics state that "energy can be transferred but is neither created nor destroyed" and energy is lost during transfer.

Life is an interaction of matter and energy. Matter moves in cycles as is the case with water, carbon or nitrogen but energy is continually lost.

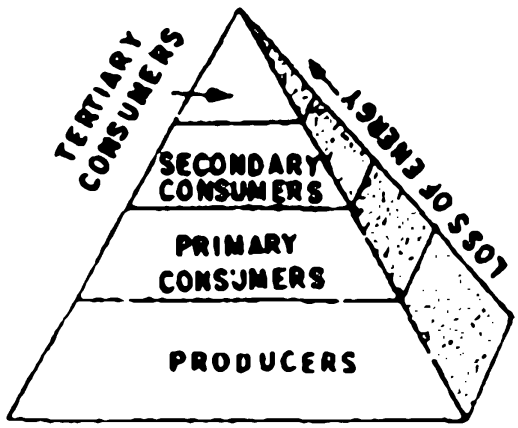
The two laws of the ecology are :

(*i*) Materials (like carbon, hydrogen, nitrogen etc.) circulate and are not lost.

(*ii*) Energy flows from organism to organism and is lost during each transfer.

12.14. Tropic level. In a food chain, each link is known as tropic level. The plants are producers and constitute the first tropic level. Herbivores or the first order consumers constitute the second tropic level and the carnivores that feed upon the herbivores from the third tropic level. Large carnivores that feed upon the small carnivores from the fourth tropic level.

12.15. Pyramid of number. The number of organisms living at each tropic level in a chain form the pyramid of number. The base of the pyramid is occupied by producers and the top is reserved for consumers. The pyramid however is never so simple. In nature lion not only feeds on deer but also on chinkara, wild bear, buffalo, sambar and four-horned antelope.



The same ecosystem may support several such pyramids each culminating in a different organism.

12.16. 10 per cent law. During the transfer of energy through successive tropic levels in an ecosystem, there is a loss of energy all along the path. No transfer is 100 per cent efficient. Lindeman in 1942 gave one of the most useful generalisations which is called "the 10 per cent law". This law states that in nature only some fraction of the energy entering any population is available for transfer to the next population that feeds upon the former. In the grazing chain about 10 per cent of the energy in the food eaten is turned into the biomass of the eater. For example, 100 kg of organic matter in grass will turn into 10 kg of flesh of a deer which in turn form 1 kg of flesh of lion that feeds on the deer.

12.17. Two important functions of food chains. The food chains not only depict structure of living component of biosphere but also two important functions. These are transfer of energy and materials. These two functions are responsible for giving dynamicity to the biosphere. This is true even for smaller constituent operational unit-ecosystems.

The transfer of energy and materials takes place in different ecosystems such as forests, grassland, pond, lake, sea, even an aquarium, park or garden. It is not in any way related to the size or shape of organisms and the factors of physical environment.

12.18. Overgrazing changes the environment. Overgrazing means too many animals eating too much in a given area. This results in this change of environment in the following ways :

1. The animals eat away green plants and leave the soil open.
2. The movement of animals makes the soil hard, compact and less airy.

Grazing makes the soil sterile. It loses its water holding capacity. In the absence of plants the rainfall becomes lesser and lesser with the passing of time. The famous Sahara desert was formed as a result of overgrazing by progressively increasing tribe of herbivores. Overgrazing also is the cause of desert in Rajasthan.

TEXT-BOOK QUESTIONS

Q. 1. Define biosphere.

Ans. Biosphere is the entire inhabited part of the earth, its water and atmosphere including the living and non-living components. The biosphere consists of two major components : ***biotic*** that includes all plants and micro-organisms ; and ***abiotic*** that includes physical environment, soil and atmosphere (gases, temperature, humidity, pressure etc.) Biophere is the combination of all the ecosystem of the earth's environment. The environment surrounding the earth can be divided into three groups.

1. Hydrosphere. It is represented by all the water on the earth that is the part of oceans, seas, rivers, streams and ponds.

2. Lithosphere. It represents the solid substratum of the earth's crust such as rocks, soil and nutrients.

3. Atmosphere. It is the gaseous cover that envelopes the hydrosphere and the lithosphere on the earth.

Q. 2. Why biosphere is considered as higher level in the organisation ?

Ans. Biosphere represents the higher levels in the hierarchy of living world organisation. All the biomes of the world constitute a single large self-sustaining biological system called biosphere. It is a sphere of living matter together with the layers of water, air and soil. Thus, biosphere has a structure, composing of biotic and abiotic components. Atmosphere, hydrosphere and lithosphere constitute the abiotic components of biosphere. Each component performs certain specific functions. The totally of all functions give biosphere a functional stability. That is why biosphere is considered as higher level in the organization.

Q. 3. Differentiate between :

(a) Lithosphere and Atmosphere

(*b*) Ecosystem and Biome

(*c*) Food Chain and Food Web

(*d*) Carnivore and Omnivore.

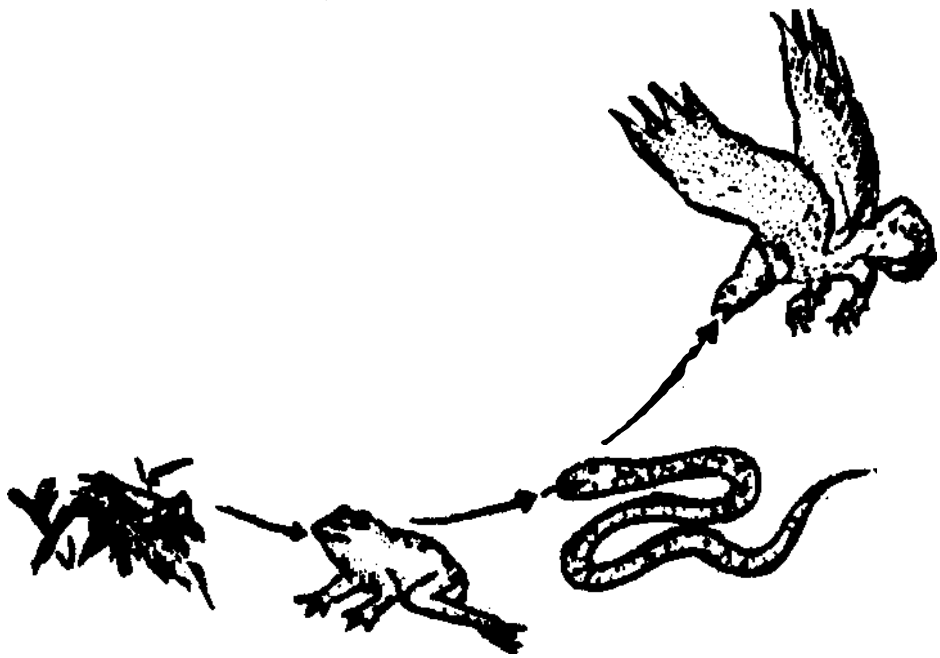
Ans. (*a*) **Lithosphere.** This is one of the abiotic components of biosphere. It constitutes earth having soil and rocks on its surface as well as below ocean water.

Atmosphere. The gaseous components of earth above the earth surface constitutes the atmosphere. It is one of the abiotic components of biosphere.

(*b*) **Ecosystem.** The relationship between a biotic community and an abiotic environment is expressed as ecosystem. A pond, a meadow, a forest all are examples of ecosystem.

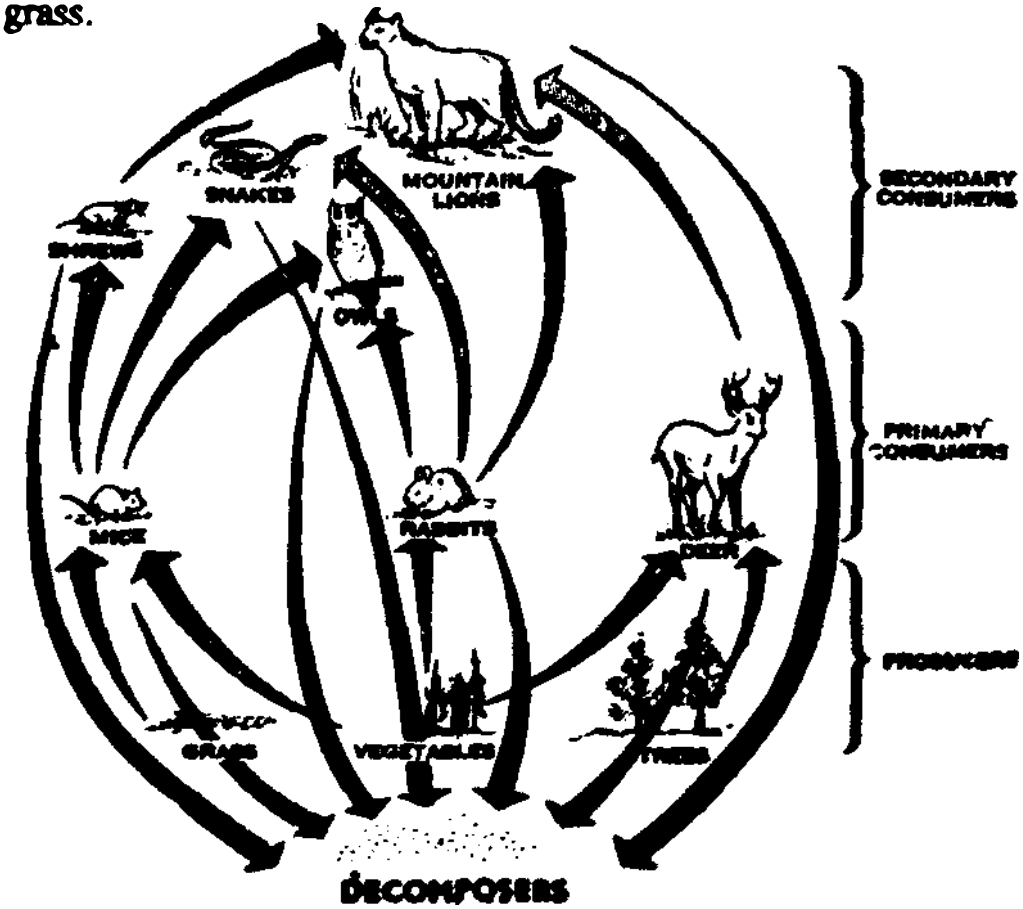
Biome. The natural ecological groupings of plants and animals, extending over large areas, are called biomes. In other words, when an ecosystem is very large like sea or desert, forest, then it is designed as biome.

(*c*) All living organisms of the biosphere are related to each other by a common factor *i.e.* food. Food provides them energy and also minerals required for their growth. In nature one organism is the food of another. The sequential process of one organism consuming the other form a food chain. A single food chain is the representative of a single energy pathway. For example, Grass is eaten up by grasshopper which is eaten by frog. Frog is eaten by snake and snake is eaten by eagle or vulture or peacock. Because many animals can eat more than one kind of food, on this account different kinds of food chains overlap each other resulting in the formation of food webs.



Food chain

In the following figure a food web is shown. From the figure it will be clear that the grass hoppers eat grass. They in turn are eaten up by many other animals like insects, shrews, which in turn are eaten up by birds. Birds are further eaten up by marten. Bear is an example which feeds upon animals as well as grass.



Food web

(*d*) **Carnivore.** The organism which consumes the flesh of other animals (prey) is known as carnivore, *e.g.*, lion.

Omnivore. The organism which consumes both plants and animals, is known as omnivore, *e.g., Man.*

Q. 4. Why we say energy flow in the biosphere is unidirectional ?

Ans. All the energy in this biosphere comes from the sun and during photosynthesis, light energy of the sun is converted into chemical energy. The plants utilize this energy for their metabolic activities. The plants are consumed by herbivorous animals. In turn, herbivorous animals are consumed by carnivores. Thus, there is a continuous transfer of energy from sun to plants and to the subsequent orders of herbivores and carnivores in a single energy pathway. So, we can say that energy flow in the biosphere is unidirectional.

Q. 5. How do food chains get shortened ?

Ans. There is a unidirectional flow of energy in the living components. It enters the living components from the non-living environment and is released as heat. The food chains in an ecosystem and even in biosphere have three or more steps. More steps means lesser amount of energy available to organisms at the extreme right of food chain.

Man being an intelligent organism can take advantageous position in the food chain by manipulation. The shortening of food chains due to man's activities leads to imbalance in the functioning of an ecosystem and ultimately the biosphere.

Q. 6. Can the food chains have more than six steps ? If not, why ?

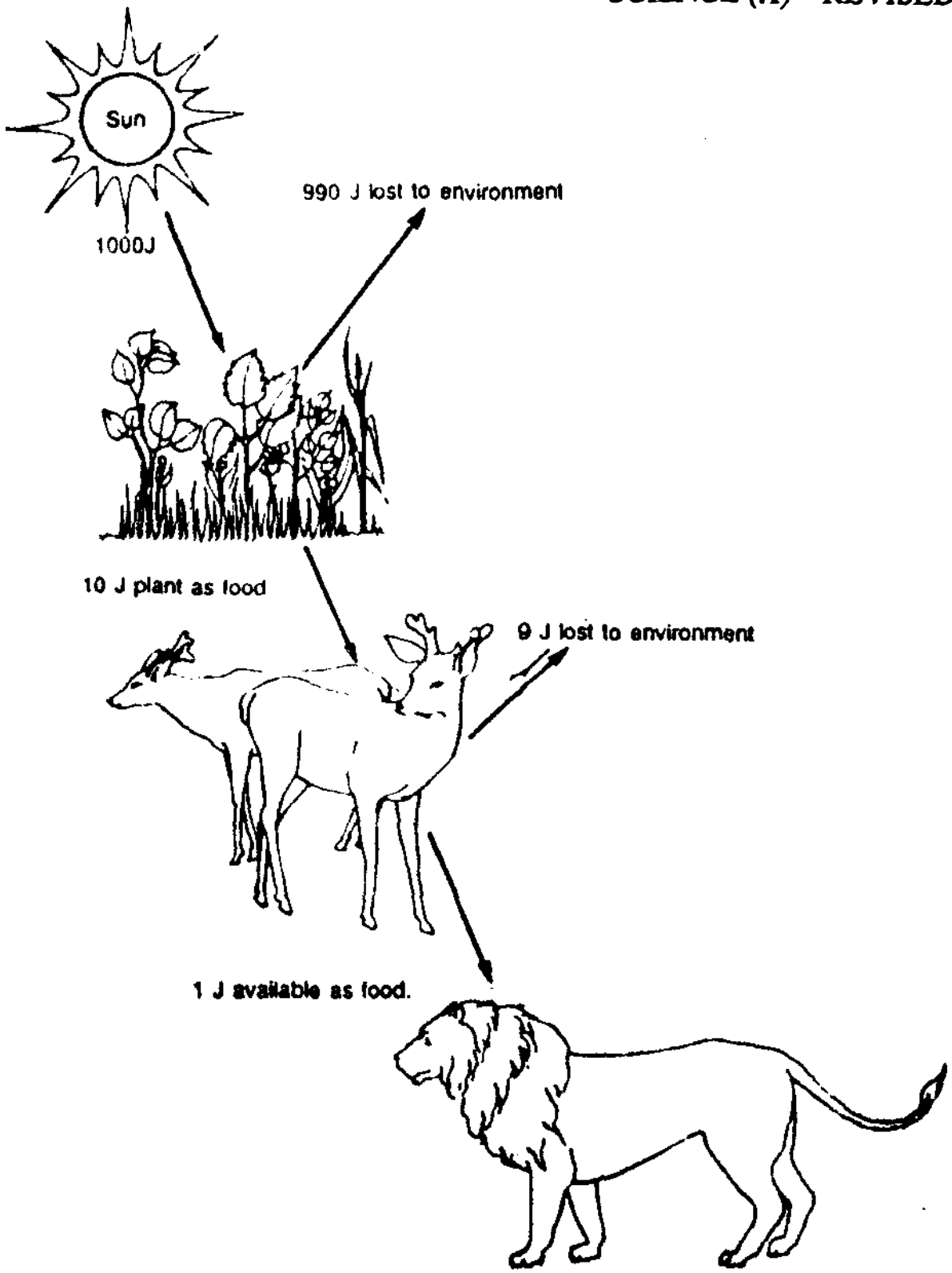
Ans. The food chains cannot have more than six steps. Some amount of energy is always lost during the transfer of energy from one tropic level to another in various food chains. Only 10 per cent of energy in the food eaten is converted into biomass of the eater. The rest of energy is lost through respiration and other metabolic processes. At each level energy is also used by organisms for their growth. Therefore the food chains cannot have more than six steps. (see figure *Food Chain* on next page)

Q. 7. Which food chains are advantageous in terms of energy ?

Ans. The shorter food chains are more advantageous in terms of energy. The producer level has more calories in energy transfers than consumer level in the food chain. This means longer food chains (more steps) result in availability of lesser amount of energy to the organisms at the extreme right of food chain. Thus, food chain having two steps is more advantageous than three-step chain and so on.

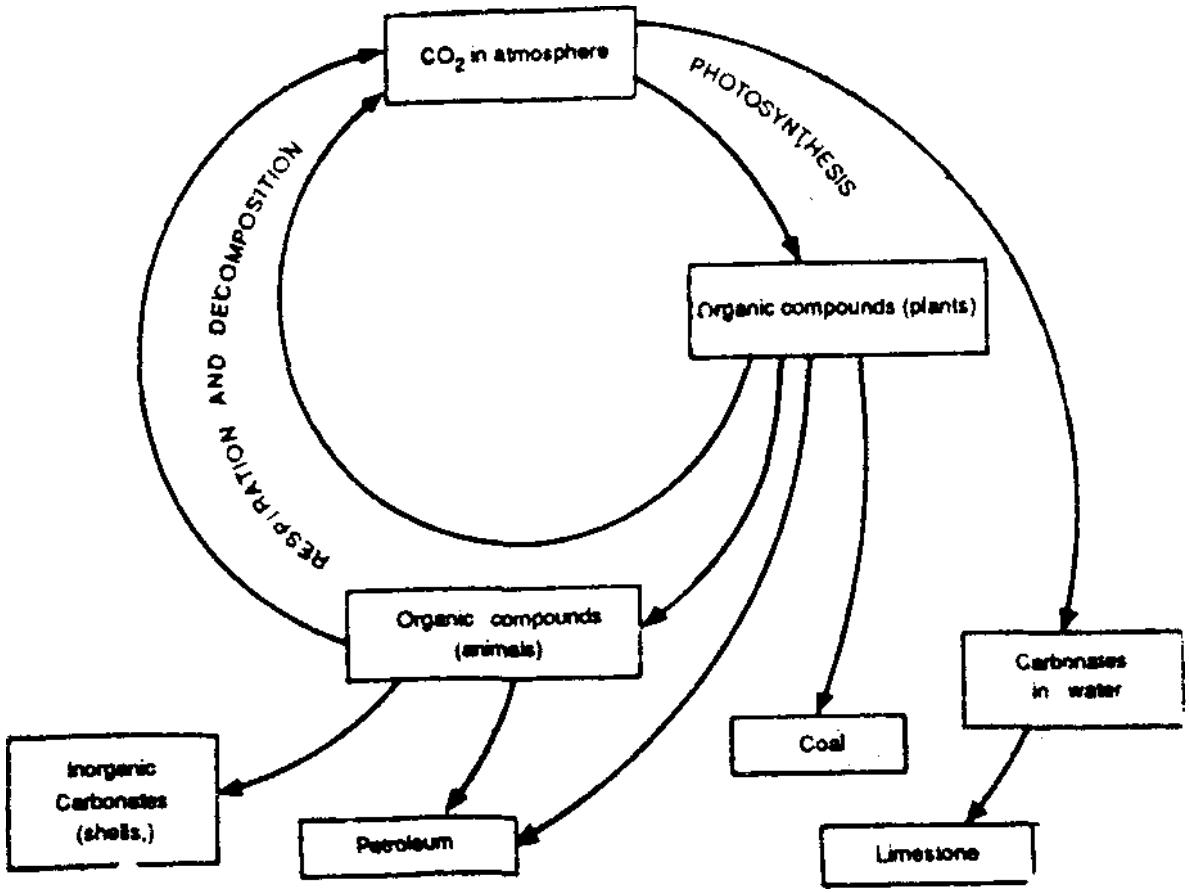
Q. 8. How carbon cycles through the biosphere ? Describe.

Ans. Carbon is a basic constituent of living organisms. It exists as carbohydrates, fats, proteins and nucleic acids. Carbon is transferred through the food chain. Atmosphere is the main reservoir of gaseous carbon, whereas oceans are the main depositors of biological carbon. In the atmosphere it is present as carbon dioxide which is about 0.03–0.04 per cent. We have studied that the plants have mechanism to utilize carbon dioxide in photosynthesis. The carbon in the form of carbohydrates travels as food to the animals in the successive tropic levels. It is returned to the atmosphere and water bodies by decomposers (Fig.). As the figure shows plants and animals release carbon dioxide to the atmosphere as a product of respiration. Carbon is also returned



Progressive decline in amount of energy available in food chain

as CO_2 through combustion of fuels, especially coal, wood and other industrial products such as gas, petroleum, etc. (Fig.). There is a continual exchange of CO_2 between atmosphere and water bodies. Volcanic eruptions also release carbon dioxide to the atmosphere.



Carbon cycle.

Q. 9. Mention briefly the role of decomposers in cycling of materials.

Ans. The various minerals circulate in a characteristic pattern from environment (soil, air and water) to organisms and back to the environment. These essential substances or minerals are C, N, O, S, P and water. These enter the producer level in the ecosystem and get transfer to the other levels. These substances or minerals are not lost from the system, unlike energy.

The decomposers like bacteria and fungi play an important role in cycling of materials. They break down the complex compounds of dead plants and animals into simpler substances. These elements are put back into circulation by release of nitrogen back to atmosphere by decaying of dead bodies of plants and animals. Thus, essentially the decomposer brings about the mineralization of organic matter.

Q. 10. What role organisms play in

(*i*) Water cycle ?

(*ii*) Oxygen cycle ?

(*iii*) Nitrogen cycle ?

Ans. (*a*) The water cycle makes the fresh water available to the organism. Water evaporates from the surface of living organisms. Water evaporated forms water vapours in the air. At low temperatures, these vapours condense into droplets. These droplets fall as rain and snow. Thus water returns to the earth.

(*b*) Organism both plants, animals and even the decomposers use oxygen available in the atmosphere for respiration. The by-product of this process, CO_2 is released into the atmosphere. Thus the percentage of oxygen in air is nearly constant.

(*c*) On the death of living beings (animals or plants) the nitrogenous compounds of their body pass into the soil or water. The excreta of animals also pass on to the soil and water.

The organic nitrogenous compounds are broken down by some bacteria to form ammonia.

Some nitrifying bacteria present in the soil oxidise ammonium ions first into nitrites and then to nitrates.

Nitrogenous compounds present in the soil are also being constantly decomposed by the action of denitrifying bacteria.

MAN AND HIS ENVIRONMENT

13.1. Environment. The physical and the biological world that we live in is our environment. Everything outside the population constitutes its environment.

13.2. Two main components of environment. The environment of any population consists of two components :

1. The living or the biotic environment.
2. The physical or abiotic environment.

All plants and animals in the surroundings of an organism constitute the biotic environment. Everything that is not alive in the surrounding like soil, water and solar radiation constitutes the abiotic environment.

13.3. Ecological balance. In nature, there exists an ecological balance. It means that the activities of various organisms in the environment which interact with each other are so finely balanced that they are in equilibrium or in a steady state.

13.4. Main components of biotic environment. The micro-organisms, plants and animals constitute the biotic environment.

13.5. Life flourish on earth. When the conditions on the earth were favourable for life to flourish, the most primitive forms of life which were unicellular first evolved in oceans. The complex and larger forms of life were evolved from unicellular organisms.

13.6. Biotic and abiotic factors affects a population. Both the biotic and abiotic environment may cause variation in the size of a population by affecting the following: (*i*) nutrient supply, (*ii*) available space, (*iii*) interaction with other organism, (*iv*) weather.

13.7. Nutrient supply affect a population. All organisms depend upon their environment for the supply of nutrients, both organic and inorganic. The supply may either be abundant or in short supply. If they are in abundance, the population will flourish. On the contrary, if the essential nutrients are missing, the population size will decrease. The presence of a particular nutrient in less than the required amount would nearly proportionately reduce the population size.

13.8. Available space affect a population. The habitable space is one of the primary needs of organisms. Individuals, pairs or family groups of animals commonly restrict their activities to a definite area called the home range. If this area is actively defended, it is called a territory. For example, the Gir forest is the home range of both lions and leopards. Both lions and leopards enjoy some part of this home range as their territory.

13.9. Interaction with other organism affect the population. The population in nature is simultaneously affected by a number of environmental factors. The interactions among the various species may be of the following three types :

1. Between the members of the same species
2. Between the members of different species
3. With the abiotic environment.

13.10. Weather affect the population. The abiotic factors like sunlight, temperature, water and pressure together form the weather. They act as limiting or regulatory factors of population size. The unequal distribution of rainfall during the year affects the density of population of many plants and animals. The density of population of some plants and animals increases sharply just after the rain and decreases with the approach of winter. Malaria parasites are rare in temperate regions but are prevalent in tropical humid regions.

13.11. Man pollutes the environment. Man is the main agent for polluting the environment. We use water to take bath, to clean our utensils, our clothes and to wash our rooms. By all these activities, we are polluting the water. Nature can be cope with a certain degree of pollution because it has its own cleaning agents. When we change the environment to such a degree that the natural agents of cleaning are incapable of restoring the balance, then it will cause pollution.

13.12. Malthus theory of population. The population is increasing at a geometric ratio whereas food production is increasing at arithmetic ratio.

Geometric progression : $2 \longrightarrow 4 \longrightarrow 8 \longrightarrow 16 \longrightarrow 32 \longrightarrow 64.$

Arithmetic progression : $2 \longrightarrow 4 \longrightarrow 6 \longrightarrow 8 \longrightarrow 10 \longrightarrow 12.$

So, there is always an increase in demand for the basic requirement of man. These are food, water, clothes and shelter. These requirements are met with through the natural resources like minerals, ground water and through agriculture.

13.13. Water table. Suppose '*x*' litres of rain water seep into the ground and raise the water table by "0" cm. If the water pumped out through bore wells is less than '*x*' litres or even equal to it, then the level of water table remains constant. The spaces between the soil particles are called pore spaces. These are generally filled with both air and water. However, below a certain depth all the pore spaces are saturated with water only. This depth is called the water table.

If man tends to use up much more water than can be replenished by natural resources, then the water table falls drastically. It causes severe damage to plants because plant roots fail to reach new level of water table and so they dry up.

13.14. Monoculture and crop rotation. Growing of the same crop on the same soil year after year is monoculture. But it depletes the soil of its main nutrients.

Crop rotation means different crops having varied requirements are grown during different seasons on the same land so that the soil is not depleted of any particular nutrient all the time.

13.15. Pollution. The undesirable change in the physical or biotic elements of the environment which affects adversely a biotic community.

13.16. Pollutant. The undesirable elements in the wrong amount at a wrong place or at the wrong time.

13.17. Air Pollution. The presence of certain chemicals, gases, particulates and any foreign materials that change the basic nature of the air is air pollution.

13.18. Water pollution. The presence of some foreign organic, inorganic, biological, radiological, or physical substance in water that tends to degrade its quality and change the normal basic structure of water.

13.19. Various sources of air pollution

(*i*) Sulphur dioxide and other particulates
(*ii*) Smoke having carbon monoxide and carbon dioxide
(*iii*) Nitrogen oxides
(*iv*) Photochemical oxidants like ozone
(*v*) Particulates of fluoride, lead, cement kiln and other dusts
(*vi*) Vapours of hydrocarbons like benzene, ethylene and other organic and inorganic substances.

13.20. *If the CO_2 content of air increases.* The increase in the concentration of CO_2 will increase the temperature of our surrounding. It will cause melting of polar ice cap and glaciers. It causes a rise in sea level and violent tidal wave resulting in flooding of the popular coastal plains.

13.21. Ecological consequences of air pollution. Man has polluted the atmosphere to such an extent that normal functioning of biotic factors is adversely affected. For example :

(*i*) Air pollution in man has caused irritation of nasal respiratory tracts and eyes, induce coughing and irrigation and pulmonary oedema and lung cancer, headache, vomiting and death from respiratory ailments.

(*ii*) In plants, the air pollution has caused stunted growth, excessive dropping of bloom and young fruits which cause impairment in plant growth.

13.22. Trees purify the air. Trees produce oxygen as a by-product of photosynthesis and use carbon dioxide in the preparation of food. The trees maintain the concentration of gases equal in the atmosphere.

13.23. Man is affecting the characteristics of atmosphere

(*i*) The concentration of CO_2 has increased by the indiscriminate cutting of trees.

(*ii*) Smoke is regularly released from industries and motor vehicles.

(*iii*) Radioactive wastes are released from atomic establishments.

(*iv*) Uncontrolled explosion of population.

13.24. Ecological consequences of water pollution by oil spills. Oil is discharged into water by accident. It is extremely toxic to aquatic life like fishes and plants. Depletion of oxygen is caused by the spilling of oil on the surface of water. It inhibits the exchange of gases with outer atmosphere.

13.25. Many big cities drain their sewage into rivers. They create pollution.

(*i*) The presence of sewage into the rivers enhances the growth of phytoplanktons. Their rapid growth depletes the dissolved oxygen. The loss of oxygen and presence of poisonous wastes affect the fish population and are unsafe for human consumption.

(*ii*) The sewage water contains disease germs, detergents and other decomposing substances, and excreta, they may cause severe disease such as jaundice, cholera etc. in human population.

13.26. Harmful effects of industrial water when it is dumped into lake or ponds.

(*i*) Industrial water contains poisonous chemicals which make the water unfit for human consumption.

(*ii*) It kills the flora and fauna in the river and removes the natural cleaning agents.

13.27. *Industrial smoke contaminate the environment.*

(*i*) Smoke contains harmful materials which make the air unsafe for breathing.

(*ii*) the solid wastes in the smoke on settling hamper the growth of plants and animals.

13.28. Acid rain. Vehicles which run on the internal combustion engine and factories emanate large amounts of sulphurous compounds in the air. During rains these compounds get dissolved in the rain water and make it acidic. This process cleans the atmosphere but the acidity of the rain water is harmful to plants and even to historical monuments.

13.29. Preservation of the resources. Renewable resources should be used only at that rate in which they are being replenished while non renewable resources must be used as less as possible.

13.30. Conservation of wild life. The first step towards conserving the wild life is to conserve the different habitats in which they live, *e.g.* tropical forests, light jungles, pine forests, wetlands, swamps, grasslands etc.

2. Animals which are endangered must be rigorously protected from being hunted. The first requirement is legislation or proper laws which forbid such hunting. The second is vigorous protection of animals by forest departments.

3. The best way to ensure that both the habitat and animals are preserved is to form as many wildlife sanctuaries and national parks as possible.

TEXT-BOOK QUESTIONS

Q. 1. List the constituents of abiotic environment.

Ans. The constituents of abiotic environment are :

(*i*) Temperature (*ii*) Light (*iii*) Pressure
(*iv*) Currents (*v*) Water (*vi*) Soil
(*vii*) Oxygen (*viii*) Nitrogen (*ix*) Carbon dioxide
(*x*) Nutrients etc.

Q. 2. What would happen if ozone layer in the atmosphere disappears ?

Ans. The ozone layer protects the living beings found on the earth from harmful radiations. It acts like an umbrella. It does not allow the ultraviolet radiations to reach the earth. The ultraviolet radiations cause skin cancer. So if the ozone layer disappears from the atmosphere the earth would be exposed to the harmful effects of ultraviolet radiations from the sun.

Q. 3. Explain socio-cultural component of your environment.

Ans. Socio-cultural component of the environment refers to the environment made by man through various activities. It includes historical, cultural, economic, political, moral and aesthetic aspects of human life. Large dams, lakes, reservoirs, small fishery tanks, aquaria, garden and parks etc. are the man-made components of the environment. All man-made socio-cultural components of the environment are simple and highly efficient. They lack the diversity of natural system. Agriculture is also a man-made ecosystem where soil is cultivated to produce the domestic economic plants. Thus, these socio-cultural components are formed due to growing abilities of man to suit their requirements. Man cannot live in isolation and his interaction with environment is the necessity of nature.

Q. 4. How the setting up of a factory on the bank of a river would affect the population down stream ?

Ans. Due to the increasing population and for his ever increasing comforts, man has been setting up various industries for the production of various types of articles. The production of various artieles – plastics, chemicals, insecticides, pesticides, medicines, leather goods and other things – various chemicals are required. During their manufacture, a lot of poisonous chemicals, substances, waste products are formed.

Normally these factories are situated at the bank of rivers. There are two reasons for this. Firstly, water is required for the running of factories. Secondly, the waste products produced as a by-product from these factories are dumped in the river water.

If the factories are situated upstream then the effluent (waste and poisonous) products get discharged on the upstream. These then travel along with the water, pollute it and go down stream. The water becomes poisonous and harmful.

People living downstream utilize water for their various needs including drinking purposes. When such a polluted water is used and utilized by people down stream it would affect their health adversely. It is therefore not desirable to dump the harmful substances – wastes, effluents in the water. These should be recycled and treated to make them harmless.

Q. 5. Why the replenishment of forests is necessary ?

Ans. The forests help us in the following ways :

1. They help in maintaining the proper and desirable climatic conditions of the area.
2. They provide shelter to various kinds of wild animals.
3. They grow many wild varieties of plants.

4. Both plants and animals form delicate, complicated food chains and food webs in the area, which bring stability and equilibrium in the environment.
5. They help in the prevention of the floods.
6. They do not allow the soil erosion.
7. They provide many useful commercial products including the timber which form the backbone of the industry.
8. In this way, the forests are very important to us.

Q. 6. List the measures for replenishment of ground water.

Ans. (*i*) People should not use more water than the rate of replenishment by the natural resources.

(*ii*) Large amount of rain-water should be collected in the catchment area. The flow of water into drains, rivers and lakes should be minimized.

(*iii*) there should be a judicious use of water sources.

Q. 7. Explain with reason the effect of growing same crop on the same land year after year.

Ans. For the growth of plants nutrients and water are required. The plants get these from the soil. Different plants – crops – require different kinds of nutrients for their growth. The soil contains limited amount of nutrients. If we grow one type of crop on the same soil year after year, the same time of nutrients are used up by the crop. Thus after some time (years) the soil becomes very poor in these nutrients which the crop requires. Due to this, the proper growth of plants does not occur. As a result of this the yield decreases. The farmers are unable to get proper returns from the crop. Due to this shortage of food occurs moreover soil also becomes useless for future use.

It is on this account that same crop is not grown on the same field year after year.

Q. 8. Define nitrogen fixation.

Ans. The roots of leguminous plants like gram, pea bear nodules, having nitrogen-fixing bacteria. These bacteria enrich the soil with nitrogen by fixing it from atmosphere. Thus, this process of enriching the soil with nitrogen is known as nitrogen fixation.

Q. 9. How does the ozone layer of the atmosphere may get depleted ?

Ans. The ozone layer in the atmosphere may get depleted due to aerosols. The aerosols chemical substances are released in the air in the form of mist or vapours by the jet aeroplanes. These react with the ozone in the stratosphere layer and cause its depletion. The aerosols contain the fluorocarbon and chlorofluorocarbons.

Q. 10. Describe the biological magnification. How recycling of waste materials help in ecological balance.

Ans. 1. The first step towards conserving the wildlife is to conserve the different habitats in which they live, *e.g.* tropical forests, light jungles, pine forests, wetlands, swamps, grasslands etc.

2. The animals which are endangered must be rigorously protected from being hunted. The first requirement is legislation or proper laws which forbid such hunting. The second is vigorous protection of animals by forest departments.

3. The best way to ensure that both the habitat and animals are preserved is to form as many wild life sanctuaries and national parks as possible.

Q. 11. How recycling of waste material help in ecological balance ?

Ans. the recycling of wastes is necessary to maintain ecological balance in nature. The explosion of human population has increased the disturbances in the global ecosystem. Due to urbanization, industries are discharging their wastes into water. Similarly sewage, garbage and huge amount of municipal and household wastes is being continuously dumped into the water. This, in turn, affects the aquatic flora and eventually disturbing the ecological balance.

Same way, the radio-active wastes from atomic reactors into the rivers and streams affect the aquatic plants and animals to a very great extent. Decentralization of garbage, sewage and refuse cause the spread of many diseases and ultimately affect the health of the public.

To overcome these difficulties, recycling of wastes is imperative so as to maintain ecological balance. Each and every species in this universe is a part of food chain and food web. If any of these species is affected, then it disturbs the ecological balance. Recently, sewage is being decomposed in sewage treatment plants so that biodegradable as well as non-biodegradable pollutants can be removed from it. Biogas plants are utilizing the agricultural and animal wastes to produce both energy and fertilizers.

Thus, recycling of wastes is one of the best way to maintain ecological balance in nature.

C.B.S.E.

SAMPLE QUESTION PAPER (2014-15)

(Issued by Central Board of Secondary Education)

Set I

SCIENCE (Class X)

Time Allowed : 3 Hrs. **Max. Marks : 75**

General Instructions :

(*i*) There are 38 questions in all.

(*ii*) All the questions are compulsory.

(*iii*) Marks for each question are indicated against it.

(*iv*) Question numbers 1 to 15 are very short answer type to be answered in one word/one sentence.

(*v*) Question numbers 16 to 30 are short answer questions of 2 marks each. Answers may not normally exceed 30 words each.

(*vi*) Question numbers 31 to 35 are short answer questions of 3 marks each. Answers may not normally exceed 40 words each.

(*vii*) Question numbers 36 to 38 are long answer questions of 5 marks each which should be answered in not more than 70 words each.

(*viii*) Answer should be brief and to the point.

Q. 1. Which other gas is present in coal gas in addition to hydrogen and carbon monoxide ? **(1)**

Ans. Methane *i.e.* CH_4.

Q. 2. While climbing a stair case which type of energy is used by us ? **(1)**

Ans. Muscular Energy or Potential Energy.

Q. 3. A triple vaccine is popularly known as D.P.T. Vaccine. Name any two diseases which are prevented by this vaccine. **(1)**

Ans. (*i*) Diphtheria (*ii*) Tetanus.

Q. 4. State the major purpose for which several National Parks and Sanctuaries are established in India. **(1)**

Ans. The major purpose to establish National Parks and Sanctuaries is to conserve the fauna and flora, wild life, gene pool.

Q. 5. What is the chemical name of baking soda ? **(1)**

Ans. Sodium bicarbonate.

Q. 6. Why a heap of coal or wood does not catch fire at room temperature though sufficient quantity of oxygen is present in air ? (1)

Ans. The ignition temperature of the heap of a coal or wood is more than room temperature.

Q. 7. Why do improperly stored cereals generally get spoiled during rainy season ? (1)

Ans. It is because cereals are attacked by pests and due to growth of moulds.

Q. 8. How is acid rain caused ? (1)

Ans. Acidic oxides present in air dissolve in water to produce acid rain.

Q. 9. Give any two effects on the local caused by Installation of heavy Industries. (1)

Ans. (*i*) Air pollution (*ii*) Rise in temperature.

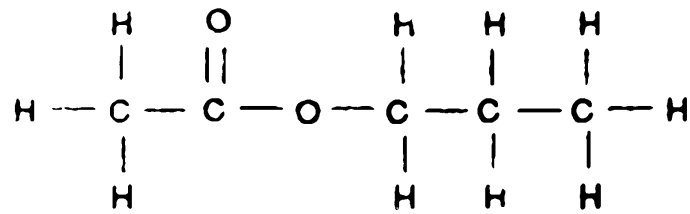
Q. 10. Classify the following substances into true solution and colloidal solution : (1)

brine, ink, common salt dissolved in water, starch dissolved in water

Ans. *True solution* : brine, common salt dissolved in water.

Colloidal solution : ink, starch dissolved in water.

Q. 11. The structural formula for an ester is



Write the formula of the acid and the alcohol from which it might be made. (1)

Ans. Acid CH_3COOH, alcohol C_2H_5OH.

Q. 12. Give any two points of difference between a star and a shooting star ? (1)

Ans. Difference between a star and a shooting star.

Star	*Shooting Star*
(*i*) It is self-luminous.	**(*i*) It is not self-luminous.**
(*ii*) It does not burn due to friction.	**(*ii*) It burns due to friction.**

Q. 13. Why does a red rose flower look red in white light ? (1)

Ans. Red rose flower looks red in white light because it absorbs all colours except red colour.

Q. 14. How does production of more paper in the world contribute to ecological imbalance ? **(1)**

Ans. The production of more paper in the world contributes to ecological imbalance because

(*i*) Raw material for paper comes from plants which needs cutting of forests trees.

(*ii*) Increase of air and water pollution from paper industry.

Q. 15. A rat placed in a trap with some food grains was sent on Mars. It did not survive on Mars ? Give two reasons. **(1)**

Ans. The rat cannot survive on Mars because

(*i*) Mars does not have oxygen.

(*ii*) The temperature is very-very low there.

Q. 16. Define the following : **(2)**

(*i*) Ultra-violet light.

(*ii*) Infra-red light.

Ans.

Ultra-violet light	*Infra-red light*
(*i*) Its wavelength is shorter than visible light.	(*i*) Its wavelength is longer than visible light.
(*ii*) It does not produce heating effect.	(*ii*) It produces heating effect.

Q. 17. Mention any two harmful effects of Nuclear Radiation on our body. **(2)**

Ans. Nuclear radiation is harmful for us because

(*i*) It damages the tissues of chromosomes (Mutation).

(*ii*) It imitates of upward cell division *i.e.* cancerous growth.

Q. 18. Write two points of difference in structure of diamond and graphite. **(2)**

Ans.

Diamond	*Graphite*
(*i*) It has tetrahedral structure.	(*i*) It has hexagonal structure.
(*ii*) All the valence electrons are used up in forming bonds.	(*ii*) The fourth valence electron of each atom is free to move.

Q. 19. What is a Solar System ? Name two planets between the sun and the earth. **(2)**

Ans. *Solar System.* The part of the universe in which the sun occupies the central position of the system holding together other heavenly bodies is called Solar System. The names of two planets between the sun and earth are (*i*) Mercury (*ii*) Venus.

Q. 20. A burner consumes 1 g of LPG in 55 seconds. If calorific value of LPG be 55 kJ/g, what will be the power of consumption of the burner ? **(2)**

Ans. We know that

$$\text{Power} = \frac{\text{Total work done}}{\text{Time taken}}$$

$$= \frac{\text{Energy}}{\text{Time Taken}}$$

(Energy is the capacity of doing work)

$$= \frac{55 \text{ kJ}}{55 \text{ sec.}}$$

$$= 1 \text{ kJ/s}$$

$$= 1 \text{ k watt. Ans.}$$

Q. 21. Establish the relationship between commercial and S.I. Units of energy. **(2)**

Ans. S.I. units of energy is Joule.

Commercial unit of energy is kilowatt hour (K.W.H.)

We know that Energy = Power × Time

$$= \text{watt} \times \text{sec.} = \text{Joule}$$

$$1 \text{ K.W.H.} = 1 \text{ kilowatt} \times 1 \text{ hour}$$

$$= 1000 \text{ watt} \times 3600 \text{ sec.}$$

$$= 3600000 \text{ J}$$

$$1 \text{ K.W.H.} = 3.6 \times 10^6 \text{ J.}$$

Q. 22. A person decides to take only milk and nothing else in his diet for certain reasons. After a year his gums start bleeding. What could be the cause of gums bleeding ? (2)

Ans. Due to scurvy disease caused due to deficiency of vitamin 'C'. Milk lacks vitamin 'C' and thus the person gets no vitamin 'C' in his diet for long. This causes gum bleeding.

Q. 23. Explain two post-harvest operations that lead to preparation of good quality seed for the next crop ? (2)

Ans. 1. Proper drying/moisture free.

2. Keeping insect free, free from foreign or unwanted substances.

Q. 24. Why is it important to conserve wild life ? How can wild life be conserved ? (2)

Ans. It is important to conserve wild life :

1. Ecological Balance
2. Preserve Gene Pool

There are many ways of conserving wild life, like :

1. Providing natural habitat in forms of National Parks and sanctuaries.
2. Proper legislation imposing total ban on extinct species and controlled hunting of different species of animals.

Q. 25. How does the big band theory explain the formation of these heavenly bodies in the universe ? (2)

Ans. (*i*) Before the formation of heavenly bodies the universe was a super dense very hot sphere. Its density was 10^{11} kg m^{-3} weighing 10^{51} kg and radius ten times that of the sun.

(*ii*) About 20×10^9 years ago, an explosion broke this ball into a large number of fragments and threw the matter in all directions, at enormous speeds in the form of galaxies.

Q. 26. A freely falling elastic ball rebounds on hitting the ground. Is the energy of the ball conserved ? If so, in which form energy appears on hitting the ground ? (2)

Ans. (*i*) Energy is conserved.

(*ii*) The transformation of energy is as follows :

(*a*) potential energy – kinetic energy

(*b*) heat energy – sound energy

Q. 27. A body possessing 840 J of energy is made to fall in 500 gm of water. If whole of the energy is converted into heat energy, calculate the rise in temperature of water. (Given specific heat of water – 4200 J kg^{-1} C^{-1}). (2)

Ans. Given $Q = 840$ J, $m = 500$ gm $= 0.5$ kg, $s = 4200$ J kg^{-1} C^{-1}

Let t be the rise in temperature then

Heat gained by water $Q = m \times s \times t$

$$\therefore \qquad 840 = 0.5 \times 4200 \times t$$

$$t = \frac{840}{0.5 \times 4200} = 0.4°C$$

Q. 28. There are three test tubes : A, B, C, each containing solutions of certain food stuffs and they showed the following tests :

(*i*) Tubes 'A' and 'C' give positive test with Benedicts solutions.

(*ii*) Tubes 'B' and 'C' give positive test with nitric acid and ammonium hydroxide.

(*iii*) Tube 'A' gives positive test with Iodine solution as well ? What are the food constituents present in the tubes A and C ? (2)

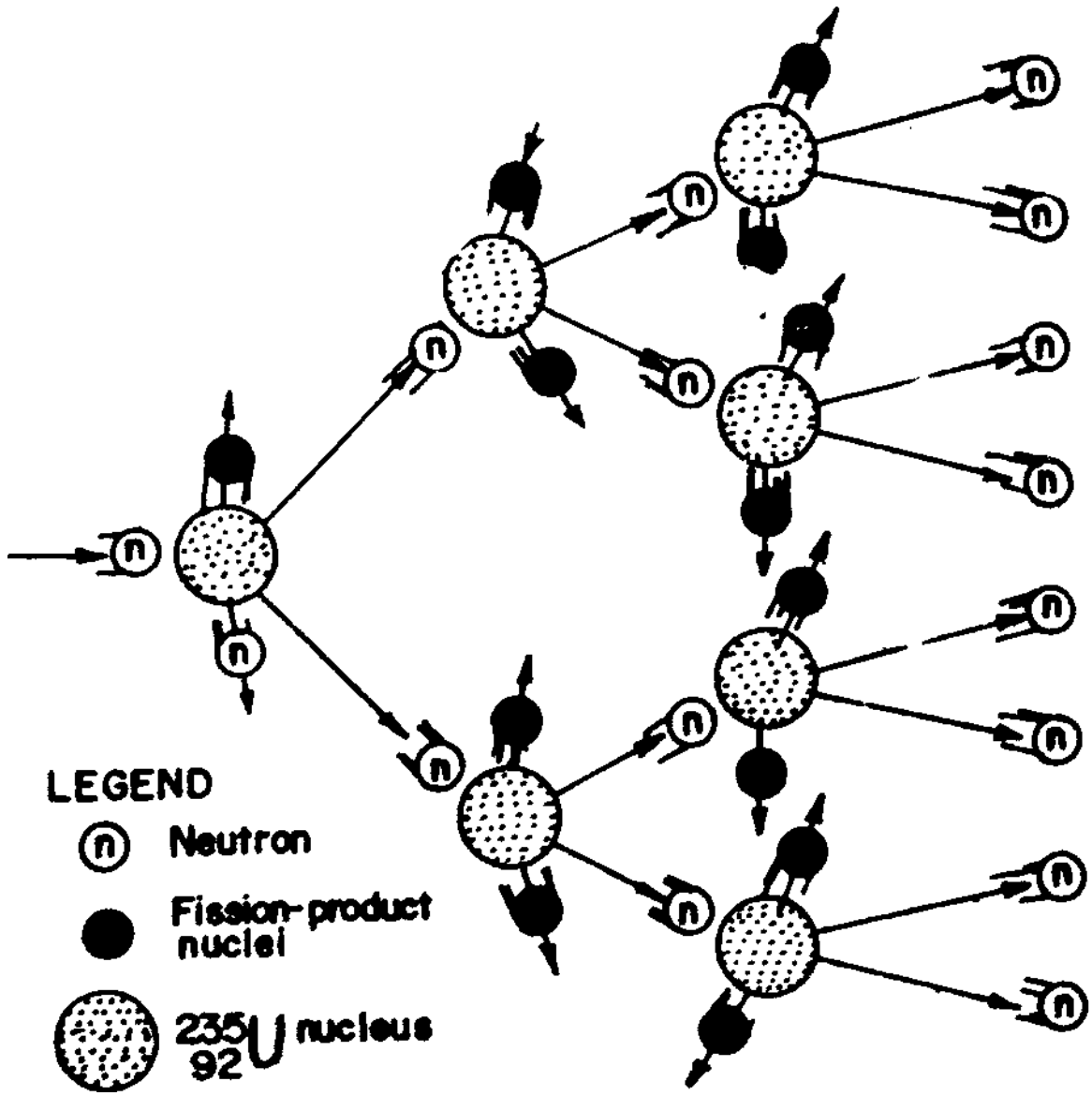
Ans.

(*i*) 'A' Test Tube contains sugar and starch.

(*ii*) 'C' Test Tube contains sugar and proteins.

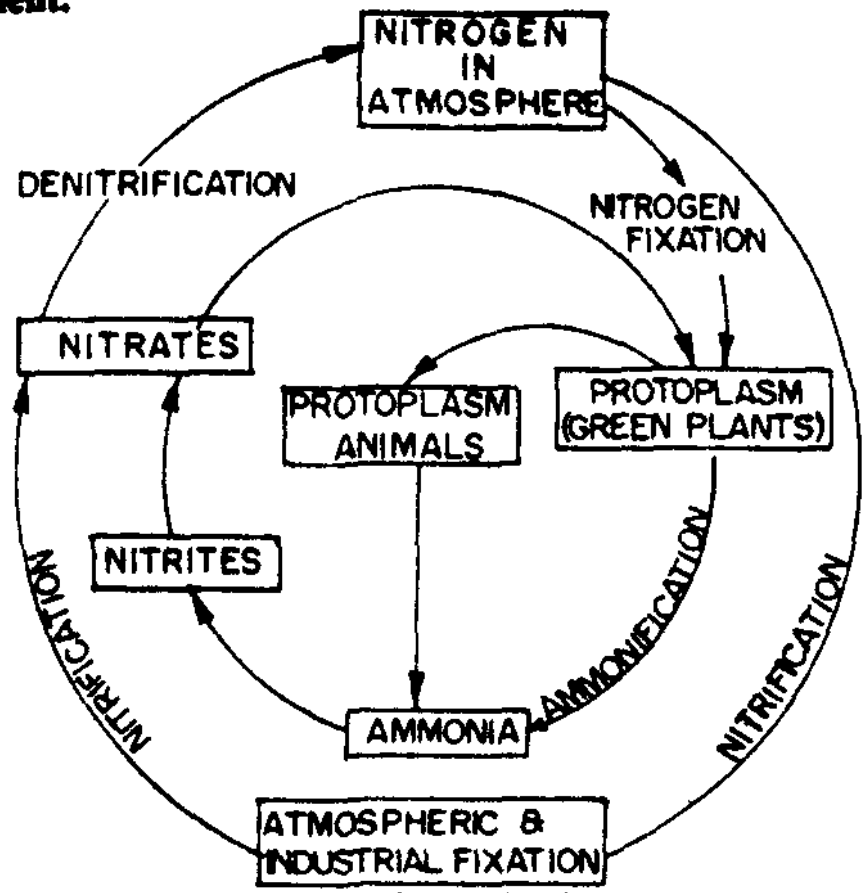
Q. 29. Draw a labelled and schematic diagram of a nuclear chain reaction taking place in U-235 nuclei. (2)

Ans.



Q. 30. Represent schematically the cycling of nitrogen in the environment. **(2)**

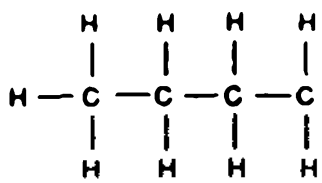
Ans.



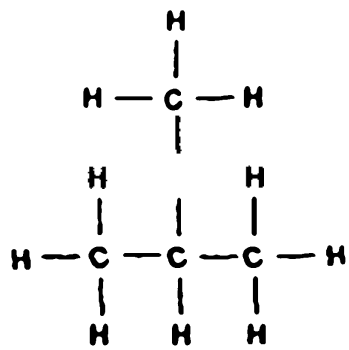
Q. 31. Define the term isomerism ? Write down the structures and names of isomers of butane. **(3)**

Ans. *Isomerism.* The compounds having the same molecular formulae but different structures, are known as isomers, and the phenomenon is known as isomerism.

Isomers of butane C_4H_{10}



Normal butane (n-butane)



Iso-butane

Q. 32. Explain how excessive use of nitrate fertilizers in agricultura fields may affect human life. (3)

Ans. The excessive use of nitrate fertilizers in agricultural fields may affect human life as follows :

(*i*) The soil and water in contact becomes rich in nitrates such water cannot be purified for drinking.

(*ii*) Excess of nitrates reaching rivers, lake and ponds leads to excessive growth of micro organism causing depletion of oxygen.

(*iii*) Ultimately leading to fish mortality and therefore less fish available as food or any other animal used as food.

Q. 33. Explain the formation of Protostar and Star ? (3)

Ans. (*i*) *Formation of Protostar* : Due to increase in gravitational attraction of the individual molecules of the H_2 cloud contracts. This dense contracting gaseous mass is called Protostar.

(*ii*) *Formation of Star* : The pressure and temperature inside the contractive mass begins to increase when the temperature is reached 10^7 °C, fusion reaction inside the star begins, protostar begins to shine and becomes star.

Q. 34. Hydrogen gas has highest calorific value, still it is not used as domestic fuel. Give three reasons for that. (3)

Ans. Hydrogen gas has highest calorific value, still it is not used as domestic fuel because :

(*i*) It is explosive

(*ii*) It is highly-inflammable

(*iii*) It is not easy to transport

Q. 35. Explain how motor vehicles are responsible for increased air pollution. Suggest two methods of checking this kind of pollution ? (3)

Ans. Motor vehicles are responsible for increased air pollution because internal combustion engine used in running various types of vehicles produce CO_2, CO, gasoline, SO_2, C_8H_{18} Octanis (gasoline) and their harmful effects.

This kind of air pollution may be checked by :

(*i*) adding tetraethyl lead to fuel

(*ii*) burning fumes in air in presence of platinum of catalyst.

Q. 36. With the help of a diagram describe Joule's experiment to establish the relationship between mechanical energy and heat. (5)

Or

Mention different types of fossil fuels. Describe a simple destructive distillation process of coal to obtain charcoal.

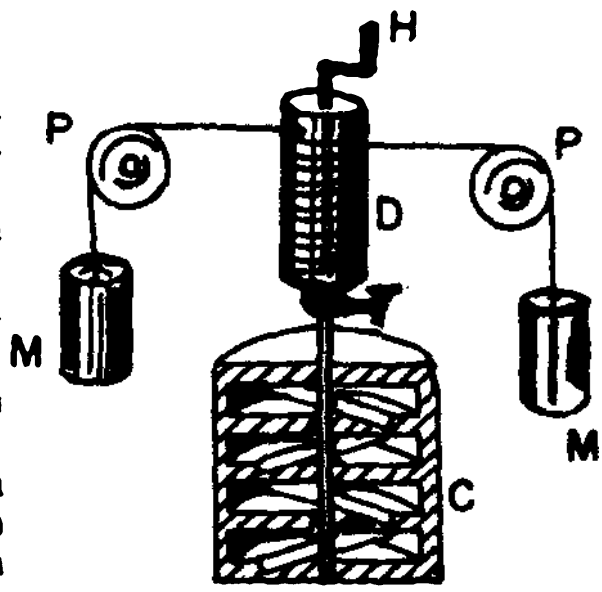
Ans. The amount of mechanical work equivalent to one unit of heat is known as the mechanical equivalent of heat. Thus, if W and H represent respectively the mechanical work and heat when one is transformed wholly into the other and J is the mechanical equivalent of heat, then $J = W/H$.

The mechanical equivalent of heat is represented by J in honour of Dr. Joule.

Value of J as determined by Dr. Joule is 10^7 ergs per Joule.

Experimental determination of J.

In the Joule's experiment, work was expanded in churning water contained in a calorimeter and the heat produced was measured from the resulting rise of temperature.



The apparatus employed by Joule consisted of the following :

(*i*) A specially constructed copper calorimeter (C).

(*ii*) A set of paddle-wheel to fit in the calorimeter.

(*iii*) a drum (D) fitted with a turning handle (H) fixed to the paddle-wheel through spindle (E).

(*iv*) a flexible cord wound around the drum and passing over the two pulleys (as shown in Fig.)

(v) Two equal weights hung by string.
(vi) A sensitive thermometer.

Procedure

The calorimeter was filled with a measured quantity of water. The weights were attached to the free ends of the string passing over the pulleys. The heights of these weights from the ground could be read with the help of a scale. The paddle was made to rotate by allowing the weights to fall. The water in the calorimeter was thus churned. The pin T was removed and the weights wound up again by turning the handle H (without revolving the paddle). The pin was inserted and the experiment repeated till the water in the calorimeter recorded a measurable temperature rise.

Calculation

Let,

Mass of water in calorimeter = m kg
Mass of each weight = M kg
Height through which each weight falls = h m
The number of falls = n
The water equivalent of the calorimeter = w kg
Rise in temperature of water in calorimeter = $t°C$
Velocity acquired by the weights on reaching the ground = v m/s

Then,

The potential energy for both the weights (in the raised position) = $2Mgh$
Kinetic energy just before striking the ground = $2 \times 1/2\, Mv^2$

Therefore,

The total mechanical energy used = $n \times (2Mgh - Mv^2)$ Joules
The total heat produced = $(m + w) \times 4184 \times t°C$

Therefore,

The mechanical equivalent of heat, $$J = \frac{W}{H} = \frac{n(2Mgh - Mv^2)}{(m+w)4184\,t}$$

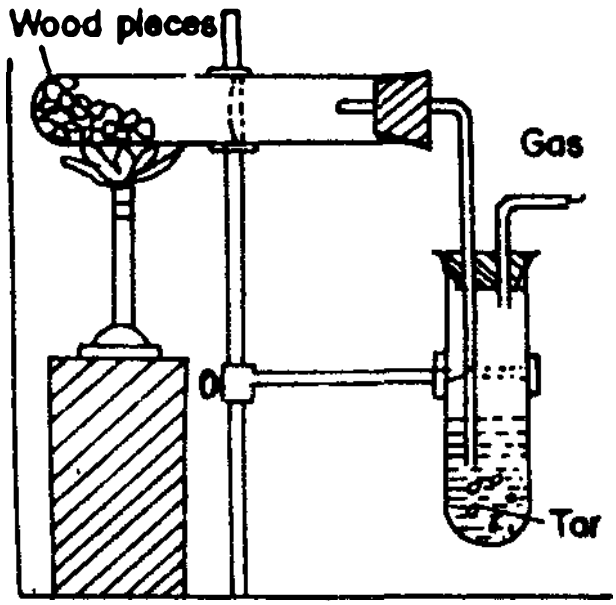
Or

Different types of fossil fuels are :
(i) Coal (ii) Petroleum (iii) Natural gas.

Distillation Process of coal (wood) to obtain charcoal

Take some small pieces of soft wood in a hard glass boiling tube. Pour some water, about 2 cm deep in another boiling tube. Assemble the equipment as shown in figure.

Heat the pieces of wood, first with a low flame and then more intensely. Drops of tar collect in the vertical tube and a gaseous mixture comes out through the open tube. On bringing a matchstick near the gas it catches fire. Stop the heating, cool the boiling tube, the black residue is charcoal. 1 kg of wood on average yields about 0.25 kg of charcol. The remainder 0.75 kg is liberated in the form of liquid and gases.



Q. 37. Metal M occurs in Earth's crust as its oxide M_2O_3. The alloy of this metal is used in making aircrafts. Explain the steps to obtain pure metal from its oxide.

Or

Metal M occurs in Earth's crust as its sulphide MS. The alloy of this metal is used in making utensils and decoration articles. Explain the steps to obtain pure metal from its sulphide.

Ans. The metal M which occurs in earth's crust as its oxide M_2O_3 is Aluminium. Its alloy duralumin is used in making aircraft.

Extracts of aluminium from its ore Al_2O_3.

(*i*) **Purification of ore Al_2O_3.** This ore of Aluminium is purified by Baiye's Process. In this method Al_2O_3 is reacted with hot NaOH from which sodium aluminate $NaAlO_2$ is formed. It is soluble in water. The gangue is separated by filteration of the aluminium is precipitated as its hydroxide.

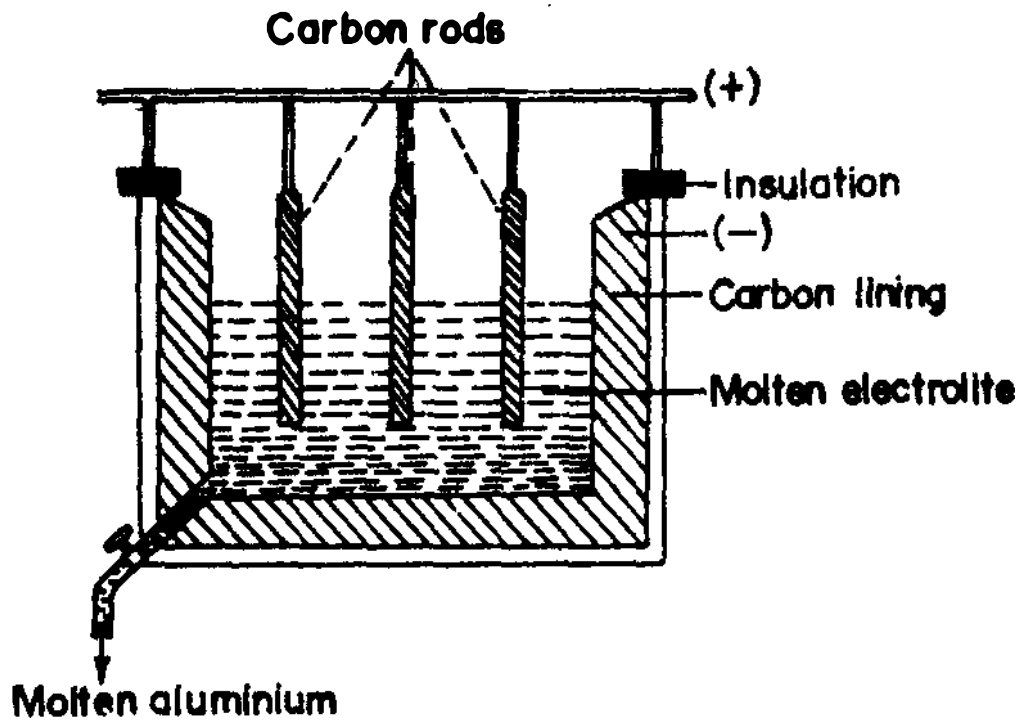
as its hydroxide.

$$Al_2O_3 \text{ (ore)} + 2\,NaOH \longrightarrow NaAlO_2 + H_2O$$

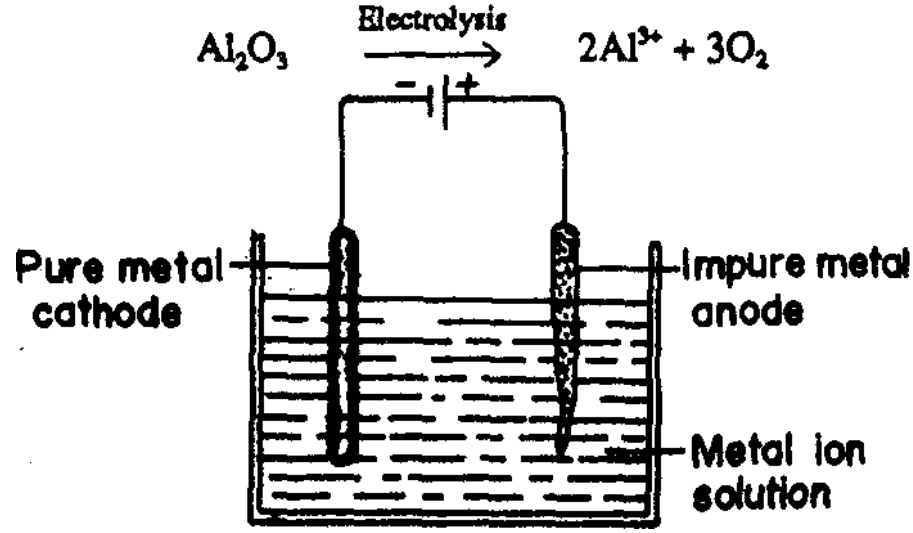
$$NaAlO_2 + HCl + H_2O \longrightarrow Al(OH)_3 \downarrow + H_2O$$

Now aluminium hydroxide is heated strongly to get pure aluminium oxide (Al_2O_3).

$$2Al(OH)_3 \xrightarrow{\text{heat}} Al_2O_3 + 3H_2O$$



(*ii*) **Electrolytic Reduction of alumina.** *Pure* Al_2O_3 *is reduced to* aluminium in a specially made electrolytic cell as shown in fig. In this cell the inside coke lining acts as a cathode and carbon rods are used as an anode. The cell is charged with a mixture of concentrated purified Al_2O_3 and cryolite (Na_3AlF_6). Cryolite is mixed to lower down the melting temperature of alumina. When the current is passed through the cell mixture melts because of the heat generated due to the resistance offered by the mixture. The molten mixture is then electrolysed and the separated aluminium collects at the bottom of the cell.



(*iii*) **Purification.** Refining is the purification of metals. Different refining processes are used for different metals. Electrolytic refining is the widely used method of purification. Many metals like copper, tin, lead, aluminium are refined.

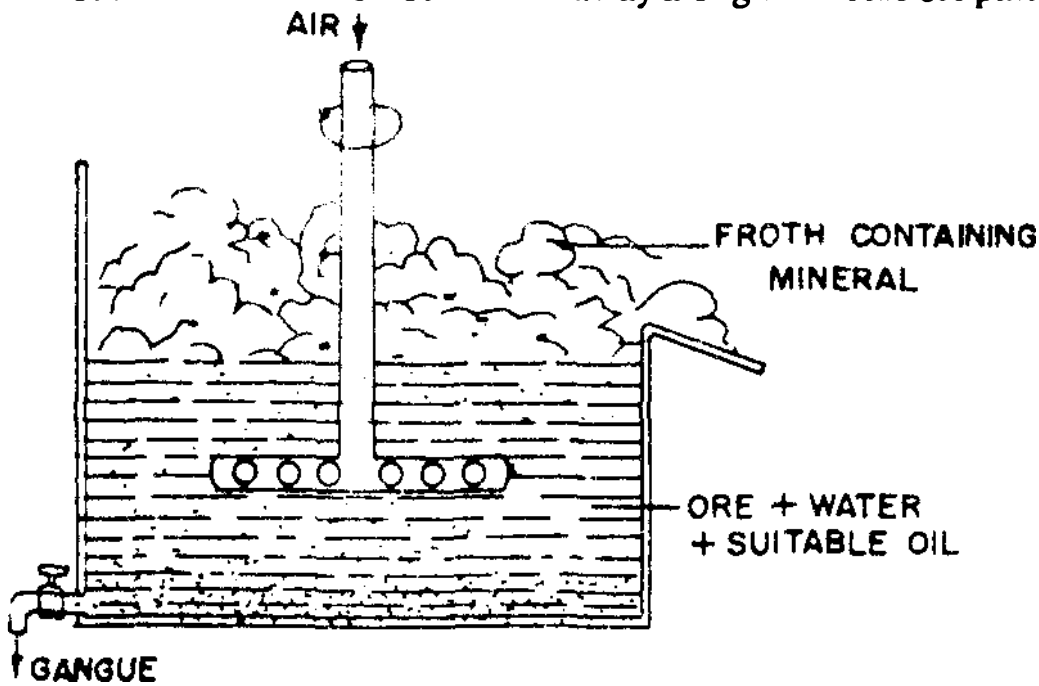
OR

The metal M whose alloy is used in making utensils and found in Earth's crust as its sulphide.

Extraction of copper from sulphide ore

The process involves the following steps :

(*i*) **Concentration.** Copper pyrites is concentrated by froth floatation process. The crushed and finely powdered ore is treated with water and pine oil in a tank. It is then agitated violently with air when a froth is formed. This froth carries away along with it the ore particles



to the surface while gangue is left behind. The foam is then washed with water to recover the ore in the concentrated form.

(*ii*) **Roasting.** The concentrated ore is roasted on the hearth of a reverberatory furnace. The following reactions take place :

$$\underset{\text{(Impurity)}}{S + O_2} \longrightarrow \underset{\text{(Volatile)}}{SO_2 \uparrow}$$

$$\underset{\text{(Impurity)}}{4As + 3O_2} \longrightarrow \underset{\text{(Volatile)}}{2As_2O_3 \uparrow}$$

$$\underset{\text{(coper pyrites)}}{2CuFeS_2 + O_2} \longrightarrow Cu_2S + 2FeS + SO_2 \uparrow$$

$$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2\uparrow$$
$$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2\uparrow$$

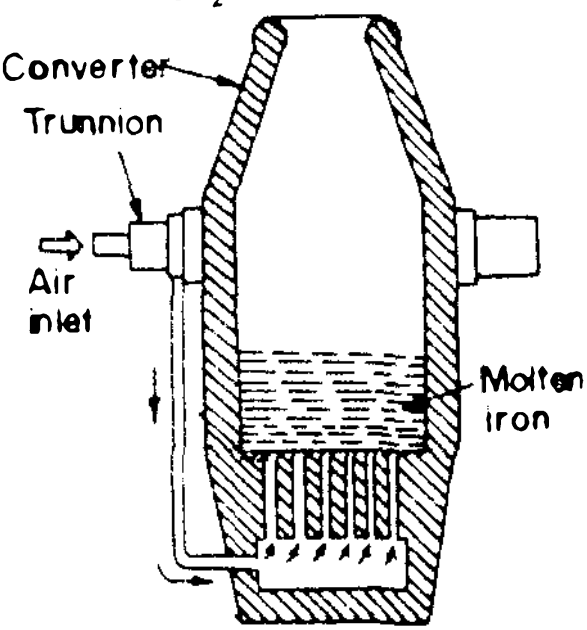
Thus, the impurities of S (sulphur) and As (arsenic) are removed as SO_2 and As_2O_3 ; and the ore is converted to a mixture of Cu_2S, Cu_2O, FeS and FeO.

(*iii*) **Smelting.** The roasted ore is mixed with sand and coke and smelted in a water jacketed blast furnace. The following reactions take place in the furnace :

$$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$$
$$FeO + \underset{\text{(sand)}}{SiO_2} \longrightarrow \underset{\text{(slag)}}{FeSiO_3}$$
$$Cu_2O + FeS \longrightarrow FeO + Cu_2S$$

Ferrous sulphide (FeS) gets oxidized to ferrous oxide (FeO) which forms fusible slag with sand. The slag is run off. Also, any cuprous oxide (Cu_2O) formed during roasting reacts with FeS to form cuprous sulphide, Cu_2S.

Thus, after smelting we obtain a mixture of cuprous sulphide (Cu_2S) and unchanged ferrous sulphide (FeS). The mixture is called matte.



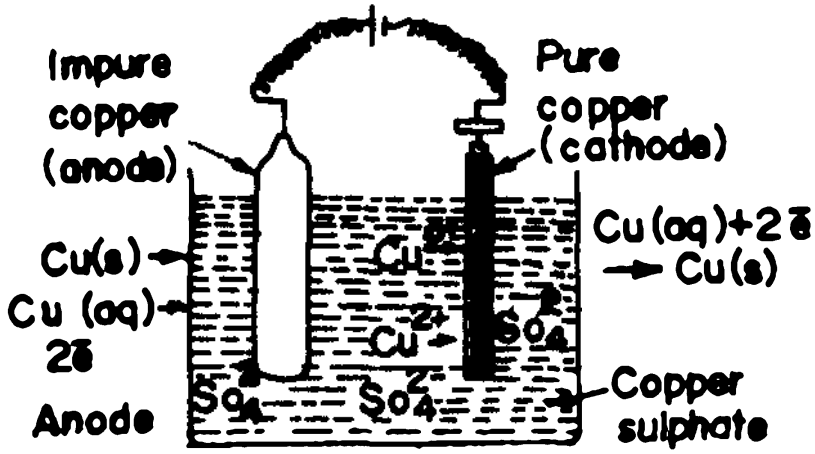
Bessemer converter

(*iv*) **Bessemerization.** The molten matte ($Cu_2S + FeS$) is introduced into the Bessemer converter (Fig.) in which hot air and sand are blown. The following reactions take place in the converter :

$$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2\uparrow$$
$$FeO + SiO_2 \longrightarrow \underset{\text{(slag)}}{FeSiO_3}$$
$$2Cu_2S + 3O_2 \longrightarrow 2\,Cu_2O + 2SO_2$$
$$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$$

Ferrous sulphide (FeS) present is changed to ferrous oxide (FeO) which reacts with sand to form fusible slag. The slag is run off. Cuprous sulphide (Cu_2S) is converted to cuprous oxide (Cu_2O) which then reacts with more of Cu_2S to form copper. The metal copper, thus obtained is called blister copper as it has blisters on it. It contains about 2% impurities.

(v) **Refining.** Copper, thus obtained, is refined by electrolytic method. Impure copper is made the anode while cathode is a sheet of pure



Refining

copper. The electrolyte is a solution of copper sulphate. On passing the electric current, pure copper starts depositing on the cathode through the electrolyte. The soluble impurities pass into the solution the insoluble impurities collect below the anode as anode mud.

Q. 38. Both the energy and mineral nutrients are continuously being transferred in the biosphere. How do these two differ in their direction of transfer ? What special points are noteworthy in respect of transfer of energy at each step ? (5)

Suppose the biotic component of an ecosystem consists of plants, grasshoppers, praying mantis, mice bears, owls and shrews. Develop the food web of this ecosystem and explain how each of these organisms obtain its food at different tropic levels ?

Ans.

(i) For energy the transfer is undirectional as solar energy is trapped by plants to produce organic nutrients.

Or

(*ii*) For mineral nutrients, the transfer *is* cyclical. It is transferred from plants to consumers and on their death, to the soil by decomposers.

(*iii*) Special points about energy transfer

(*i*) Light energy is converted into chemical energy by green plants. This is the first tropic level.

(*ii*) There is a progressive decline in the availability of energy.

(*iii*) There is loss of energy at each step of transfer. About 10% of the energy is transferred from one tropic level to the next *e.g.* from deer to lion.

Or

(*i*) Food web : Any four food chain correctly linked.

Food web is the inter-linking of food chain.

Plants – grasshopper – shrews – owls

Plants – grasshopper – praying mantis – owls

Plants – mice – owls

Plants – bears

Plants – mouse – bear

(*ii*) Explanations of six organisms at different tropic level.

(*i*) Plants at I tropic level

(*ii*) Mice at II tropic level

(*iii*) Grasshopper at II tropic level

(*iv*) Praying mantis at III tropic level

(*v*) Shrews at III and IV tropic level

(*vi*) Bears at II, III, IV and V tropic levels

C.B.S.E.

SAMPLE QUESTION PAPER (Solved)

(Issued by Central Board of Secondary Education)

Set II

SCIENCE (Class X)

Time Allowed : 3 Hrs. **Max. Marks : 75**

General Instructions :

(*i*) There are 38 questions in all.

(*ii*) All the questions are compulsory.

(*iii*) Marks for each question are indicated against it.

(*iv*) Question numbers 1 to 15 are very short answer type to be answered in one word/one sentence.

(*v*) Question numbers 16 to 30 are short answer questions of 2 marks each. Answers may not normally exceed 30 words each.

(*vi*) Question numbers 31 to 35 are short answer questions of 3 marks each. Answers may not normally exceed 40 words each.

(*vii*) Question numbers 36 to 38 are long answer questions of 5 marks each which should be answered in not more than 70 words each.

(*viii*) Answer should be brief and to the point.

Q. 1. Holstein, Jersey and Sahiwal are the high yielding breeds of a certain domestic animal. Name the animal. Mention one more high yielding breed of the same animal. **(1)**

Ans. (1) Cow (2) Karan Fries

Q. 2. Name two main abiotic factors which affect human environment ? **(1)**

Ans. (1) Rainfall (2) Temperature.

Q. 3. Give the general name of the class of compounds having the general formula C_nH_{2n-2}. Write name of the first member of this homologous series. **(1)**

Ans. Name of the class-alkynes

Ist member of this series — acetylene (Ethyne) C_2H_2.

Q. 4. Which part of the sun light is used in heating a solar cooker ? **(1)**

Ans. Infra-red light.

Q. 5. Mention two important uses of Nuclear Energy. **(1)**

Ans. (*i*) Generation of electricity (*ii*) Production of isotopes for use in medicine or research etc.

Q. 6. How does roughage differ from concentrates with reference to cattle feed ? **(1)**

Ans. Roughage is (*i*) fibrous, (2) Low nutrient material. On the other hand concentrates are rich in one or more nutrients.

Q. 7. How do vultures and kites form an important constitnent of biotic community ? **(1)**

Ans. Vultures and kites are scavengers which feed on dead organisms.

Q. 8. 'All stars except the polar star, appear to move from east to west'. Give reasons. **(1)**

Ans. All the stars except the polar star appear to move from east to west because

(*i*) earth moves from west to east (*ii*) Pole star lies on the axis of rotation of earth.

Q. 9. What kind of energy transformation takes place in a toy bus driven by a winding key ? **(1)**

Ans. In this case potential energy transforms into kinetic energy.

Q. 10. In which order will the components of a mixture of water, methyl alcohol and kerosene be collected by fractional distillation ? The boiling points of water, methyl alcohol and kerosene are 100°C, 60°C and 270°C respectively. **(1)**

Ans. The order of the substance collected by fractional distillation is methyl alcohol. water and kerosene.

Q. 11. An agriculture extension worker talking to farmers said, "For obtaining good wheat crop the use of fungus — resistants seeds, heavy tilling, good supply of fertilizers and irrigation after maturity of crops are needed ?" Which part of the statement is not correct ? **(1)**

Ans. Irrigation after maturity

Q. 12. If the polar ice cops begin to recede and low lying land areas begin to flood with water due to rise in atmospheric temperature. What change in the composition of air is responsible for it ? **(1)**

Ans. Increase in CO_2 in the atmosphere causes the rise in temperature of the atmosphere.

Q. 13. Metal 'M' reacts with oxygen to form metallic oxide (MO). This oxide reacts with moisture and carbondioxide of the atmosphere to form a basic carbonate. Metal M prevents rusting of iron. Identify metal M. (1)

Ans. Zinc.

Q. 14. A sculpture made up of bronze was kept in an Art Gallery. After some time the sculpture lost its lustre due to a greenish layer on it. What is the cause of this phenomenon ? (1)

Ans. It is due to acidic oxides presence in the atmosphere, the metal corrodes.

Q. 15. What is the basic difference between nuclear fusion and nuclear fission ? Which of the two is used in a Nuclear Reactor ? (1)

Ans. Nuclear fission. It is the nuclear reaction which involves splitting of heavier and bigger nucleus into smaller and lighter nuclei by bombardment of slow-moving neutrons. One of the possible reactions which takes place during nuclear fission of heavier U-235 is given below.

Nuclear fusion. Fusion reaction is quite opposite of nuclear fission. In such a reaction light nuclei combine to form heavier nuclei accompanied by the release of enormous energy. For example, two light deuterium nuclei $^{2}_{1}H$ fuse together to form a helium nucleus $^{4}_{2}He$ releasing 23.01×10^{8} kJ energy per mole of helium nucleus formed. Fission is used in Nuclear Reactor.

Q. 16. Draw the shape of ursa major showing the position of stars. (2)

Ans. see Fig.

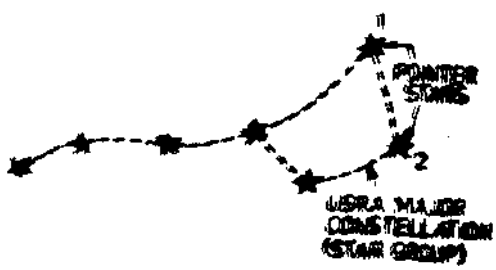


Fig.

Q. 17. What is kwashiorkor ? Name any two rich food sources to prevent it ? (2)

Ans. Kwashiorkor is a disease caused by severe protein deficiency.

Two rich food sources are : (*i*) Milk (*ii*) Egg.

Q. 18. Explain what happens when (2)

(*i*) a beam of light is passed through a colloidal solution.

(*ii*) an electric current is passed through a colloidal solution.

Ans. (*i*) When light passed through a colloidal solution, its path becomes visible.

(*ii*) On passing electric current through colloidal solution, its particles move either towards cathodes or the anode.

Q. 19. Name the process by which energy is released in the sun. Explain why cannot this process be used in the laboratory to produce energy ? (2)

Ans. Nuclear fusion occurs in the sun.

This process cannot be used to produce energy in the laboratory, because it is not possible to create excessive higher temperature required for nuclear fusion, under laboratory conditions.

Q. 20. Differentiate between active smoking and passive smoking. Explain which one of these is more injurious to health and why ? (2)

Ans. Active smoker smokes the cigarette. Passive smoke is a non-smoker who inhales the smoke that fills the air around him.

Passive smoking is more dangerous than active smoking because it cannot be controlled. Active smoking is more harmful because he inhales the smoke both as active and passive smoker.

Q. 21. Given below is an example of food chain.

Grass ⟶ Grass hopper ⟶ Frog ⟶ Snake ⟶ Peacock

What will happen to the members of the different tropic levels in this food chain if all the frogs of that area were removed ? (2)

Ans. (*i*) Grasshopper's population will increase.

(*ii*) Grass will become less.

(*iii*) There will be struggle for existence among the grasshoppers.

(*iv*) Snake and Peacock may move to other areas.

Q. 22. What is the basic difference between simple distillation and fractional distillation ? Which of the two is used in refining Petroleum and why ? (2)

Ans. In simple distillation, the higher boiling liquid is condensed whereas lower boiling liquid remains behind *e.g.* alcohol and water mixture.

Fractional distillation used for a mixture of three or more liquids.

Fractional distillation is used in refining Petroleum. Petroleum is a complex mixture of substances such as gaseous fuels, gasoline, kerosene, gasoil, diesel oils, lubricating oil etc. with different boiling points.

Q. 23. A solution of $CuSO_4$ was kept in an iron pot. After a few days, the iron pot was found to have a number of holes in it. Write the equation of the reaction that took place. Explain this reaction in terms of reactivity. (2)

Ans. The reaction takes place as under

$$Cu^{2+}(aq) + Fe(s) \longrightarrow Fe^{2+}(aq) + Cu(s)$$

It is displacement reaction. Here copper is displaced by iron because iron is more reactive than copper.

Q. 24. Why does the size of a star change in the red giant phase ? (2)

Ans. In the interior of the star hydrogen is converted into helium due to fusion. The pressure inside would drop and it would contract under its own gravity. However the outer shell will continue to fuse. The shell would begin to expand, increasing its surface area and reducing the intensity of radiated energy. That is why the size of a star changes in the red giant phase.

Q. 25. Which one of the following compounds will have lowest calorific value and why ?

(*i*) CH_4 Methane

(*ii*) C_2H_6 Ethane

(*iii*) $C_{12}H_{22}O_{11}$ Sugar (2)

Ans. Sugar ($C_{12}H_{22}O_{11}$) has lowest calorific value, because oxygen present in it reduces the calorific value.

Q. 26. A patient was advised by his doctor to include citrus fruits in his daily diet. Name the disease which the patient was suffering from and mention its two symptoms ? (2)

Ans. (1) Scurvy. Two symptoms are :

(*i*) Swollen and bleeding gums

(*ii*) Pain in joints and loosening of teeth

Q. 27. A deforested land has been reforested. Mention any four changes which will be brought about in the water cycle of that area ? (2)

Ans. (1) As a result of increased transpiration there is increase humidity in air.

(2) More precipitation (rain)

(3) Water level will rise.

(4) Soil will retain more water and there will be less flood.

Q. 28. Why cannot we use the natural satellite moon, for communication purposes ? (2)

Ans. We cannot use the natural satellite moon, for communication purposes because

(*i*) the distance between earth and moon is too large.

(*ii*) Moon is not rotating in the equatorial plane of the earth.

(*iii*) Time of revolution of moon is not 24 hours.

Q. 29. Make a schematic diagram of carbon cycle ? (2)

Ans. Carbon Cycle showing following in an appropriate sequence :

(1) CO_2 from air into plants (Photosynthesis)

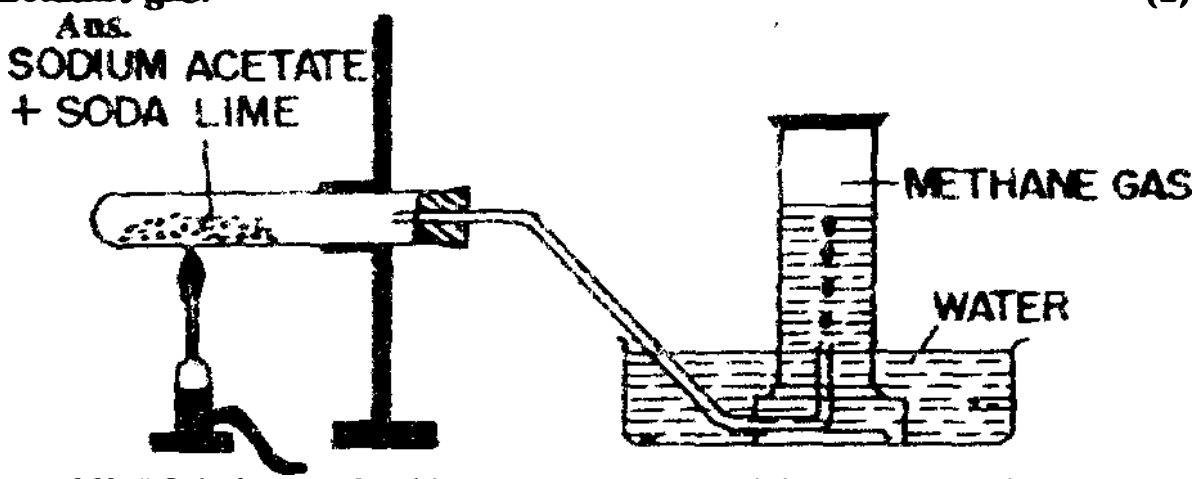
(2) Animals consume carbohydrates of the plants.

(3) Plants and animals release CO_2 back to air.

(4) Burning of dead organic matter and fuels as well as decay of dead organisms also release CO_2 back to air.

Q. 30. Draw a labelled diagram for the laboratory preparation of methane gas. (2)

Ans.



CH_3COONa + $NaOH$ ⟶ Na_2CO_3 + CH_4

(Sodium Acetate) (Soda Lime) (Sodium Carbonate) (Methane)

Q. 31. What is Combustion ? State conditions essential for combustion of fuels. (3)

Ans. Combustion. Combustion means burning. During combustion an element or a compound combines with oxygen. It is an exothermic process *i.e.* in this process heat is given out.

Essential conditions for combustion of fuels are :

(*i*) Presence of a combustible substance.

(*ii*) Attainment of ignition temperature by the combustible substance

(*iii*) Presence of supporter of combustion (O_2)

Q. 32. Explain structure of different layers of Earth ? (3)

Ans.

(*i*) Lithosphere forms solid part of the earth made of metals and certain other elements and compounds.

(*ii*) Hydrosphere forms liquid part of the earth made up of aquatic plants and animals.

(*iii*) Atmosphere forms an air envelop provide region for birds and made of gaseous elements such as Hydrogen, Carbon.

Q. 33. Give three reasons why use of cow dung in biogas plant is preferred to burning cow dung cakes for cooking ? (3)

Ans. (*i*) Waste is used as fertilizer.

(*ii*) No smoke produced.

(*iii*) No harmful gases produced.

Q. 34. Fission of one U-235 nucleus releases 3.2×10^{-11} J of energy. Calculate the number of fissions required to produce energy at the rate of 5 mW for one day in a generator. (3)

Solution. Energy to be produced per day

$$= 5 \text{ mW}$$

$$= 5 \times 10^{-3} \text{ W} = 5 \times 10^{-3} \text{ J/sec}$$

$$= 5 \times 10^{-3} \times 24 \times 60 \times 60 \text{ J} \qquad (1 \text{ mW} = 10^{-3} \text{ W})$$

$\therefore$ 3.2×10^{-11} J of energy is produced by fission of one U-235 nucleus.

$\therefore$ $5 \times 10^{-3} \times 24 \times 60 \times 60$ J of energy will be produced by

$$= \frac{5 \times 10^{-3} \times 24 \times 60 \times 60}{3.2 \times 10^{-11}} = 135 \times 10^{2} \text{ fissions.}$$

Q. 35. A farmer grows wheat crop in a field year after year. He finds that the yield becomes low. Give possible reasons for it. What advice would you give him to prevent this situation ?

Ans. (A) The soil gets depleted in nutrients specially nitrogen.

(B) (*i*) Rotation of wheat crop with leguminous crop.

(*ii*) Mixed cropping *e.g.* Wheat with gram.

(*iii*) Use of fertilizers and manures.

(*iv*) Green manuring before sowing wheat crop.

Q. 36. How do the following organisms spoil food in fields and stores ? (5)

(*i*) Rodents

(*ii*) Birds

(*iii*) Micro-Organism.

Ans. (*i*) Rodents

(*ii*) Feed on grain, Destroy grain by cutting.

Q. 37. Mention five points of difference between External and Internal Combustion Engines. (5)

Ans. Although both the types of engines convert heat into the mechanical energy, but they differ in some aspects. The main differences are :

External Combustion Engine	*Internal Combustion Engine*
(*i*) The fuel is burnt outside the cylinder of the engine.	(*i*) The fuel is burnt inside the cylinder of the engine.
(*ii*) The piston moves due to the expansive action of the superheated steam.	(*ii*) The piston moves due to explosive force generated by the combustion of the fuel (general, fuel + air mixture) in the cylinder of the engine.
(*iii*) These engines are quite bulky.	(*iii*) These engines are small.
(*iv*) Thermal efficiency is low (= 20%).	(*iv*) Relatively higher thermal efficiency (= 30 – 35%).
(*v*) It is not used widely.	(*v*) It is extensively used.

Q. 38. An industrial plant was set up for the extraction of copper from its sulphide ore at a distance of just 1 km from the city. Explain the harmful effects of any five gaseous pollutants that would be given out by this industrial plant. (5)

Ans.

(*i*) Carbon monoxide (CO). It is extremely poisonous gas. Large amount of this gas inhaled can be a cause of death.

(*ii*) Carbon dioxide (CO_2). This gas is less harmful. But excess of CO_2 will be able to rise the atmospheric temperature. It will also reduce the level of O_2 in air.

(*iii*) SO_3, SO_2 and H_2S. All these gases are highly suffocating and corroding.

NOTES

NOTES

NOTES

1

ENERGY

Q.1. Mention any two differences between a petrol and a diesel engine. **[NCERT, Q. 1]**

Ans. Following are the differences between a petrol and a diesel engine :

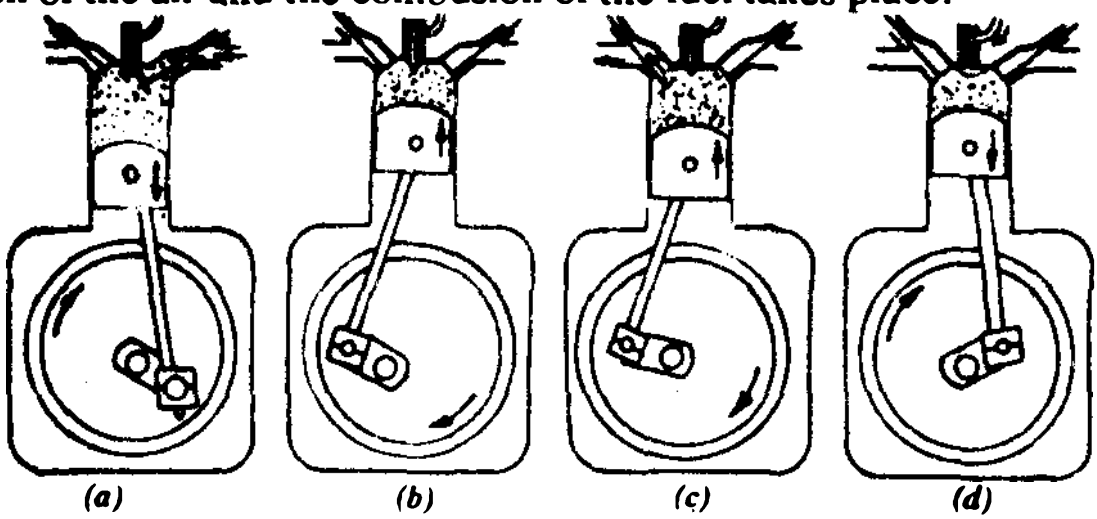
	Petrol engine		*Diesel engine*
1.	In petrol engine the ignition of fuel is done by the spark plug.	1.	In a diesel engine, no spark plug is used.
2.	In compression stroke, the fuel mixture (petrol vapour and air mixture) is compressed to about $\frac{1}{8}$th of its original volume. The petrol-air mixture gets heated and ignition takes place in next stroke.	2.	In compression stage, the air is compressed by the piston in the cylinder to $\frac{1}{16}$th of its initial volume. The temperature of air becomes 1000°C. At this point fuel is injected into the cylinder in the form of fine spray. The fuel ignites immediately.
3.	Diesel engines are used in buses, trucks and motor cars.	3.	Petrol engine is used in motor cars, scooters.

Q. 2. Explain the principle of working of a diesel engine.
[NCERT, Q. 2]

Ans. The working of a diesel engine is divided into four stages called "four strokes" of the engine.

(i) **Intake.** In intake stage air is sucked in the cylinder.

(ii) **Compression.** In compression stage, the air is compressed to $\frac{1}{16}$th of the initial volume by the piston fitted in the cylinder. In the process of compression, the temperature of air becomes very of the order of 1000°C. At this point fuel is injected into the cylinder in the form of fine spray. Since the temperature of the air is very Righ, the fuel ignites immediately. As a result, the hydrocarbons present in the fuel combines with oxygen of the air and the combusion of the fuel takes place.



Diesel engine : (a) Intake Stage ; (b) Compression stage ; (c) Expansion Stage ; (d) Exhaust Stage.

(iii) **Expansion.** The combustion of the fuel produces gases like carbon dioxide, carbon monoxide, water vapour and heat. The pressure of the hot gases so produced is very large which pushes the piston back. The hot gases get cooled in this process.

(iv) **Exhaust.** The piston is brought back to initial position by a special mechanism to receive another intake of air. During

this period the exhaust valves open up to allow the relatively cooler exhaust gases to go out.

Q. 3. Explain why efficiency of solar heating devices is much lower than similar devices operated on electricity.

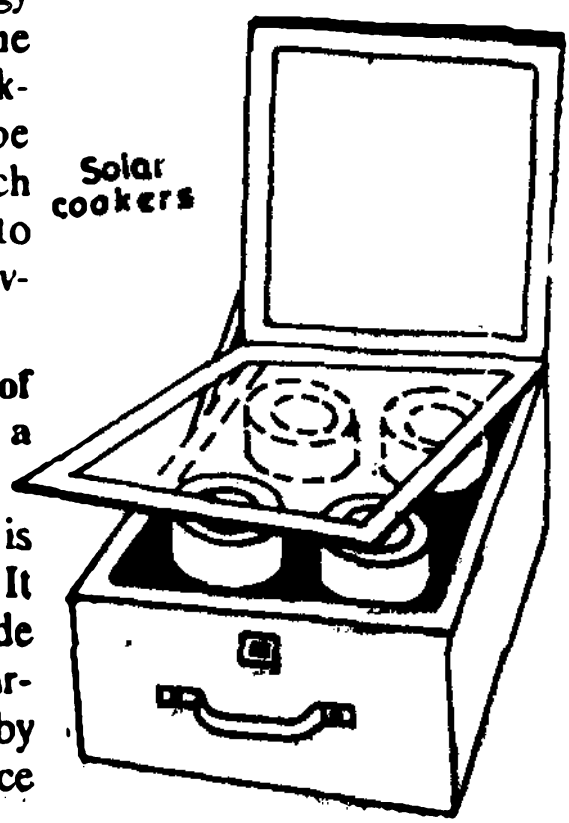
[NCERT, Q. 3]

Ans. Every square metre of earth's upper atmosphere receives 1.30 kJ of energy per second. Of this only 47% energy reaches every square metre of earth's surface in one second. Even this amount of energy is not available uniformly. It also keeps on changing every day at a place, besides changing from place to place during a day. It is for this reason, efficiency of solar heating devices is much lower than similar devices operated on electricity.

Q. 4. Draw a labelled diagram of a box type solar cooker.

[NCERT, Q. 4]

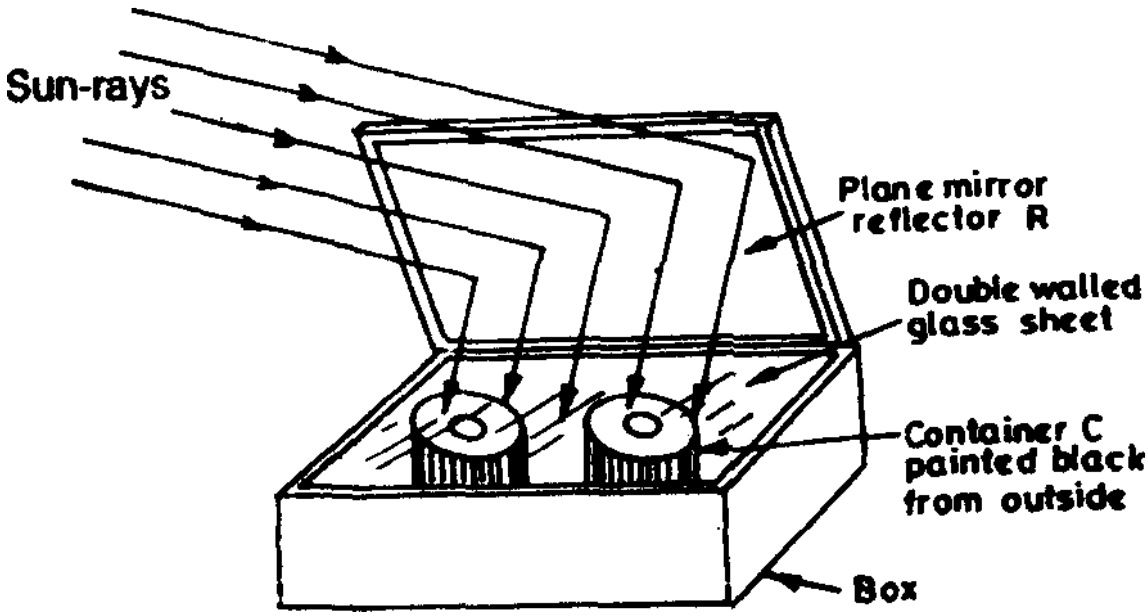
Ans. A box type solar cooker is shown in figure. It works on the principle that the incident energy from the sun is reflected into the interior of the box over the blackened cans contains the food to be cooked. Heat radiations which enter the box, are not allowed to escape by a glass sheet which covers the blackened cans.



Q. 5. Discuss the function of solar cooker with the help of a neat diagram.

Ans. In solar cooker food is cooked by using solar energy. It consists of an insulated box made of fibre glass and this box is thermally insulated from inside by using glass wool. Inside surface

box is painted black, as black colour is good absorber of heat. The upper surface of box is covered with double glass sheet. Four containers cooked black from outside are kept inside the box, in which food is cooked. There is a plane mirror reflector 'R' which is fitted on the cover of the box and can be so adjusted that sun rays falling on this reflector fall on the double-walled glass sheet.



Working. Food (pulses, vegetables etc.) which is to be cooked is kept in the containers and then containers are kept inside the box. Solar Cooker is placed in the sunlight and its reflector R is so adjusted that a strong beam of sun light falls over the top double glass sheet. These sun rays pass through the glass sheet and are absorbed by the black surface in the box.

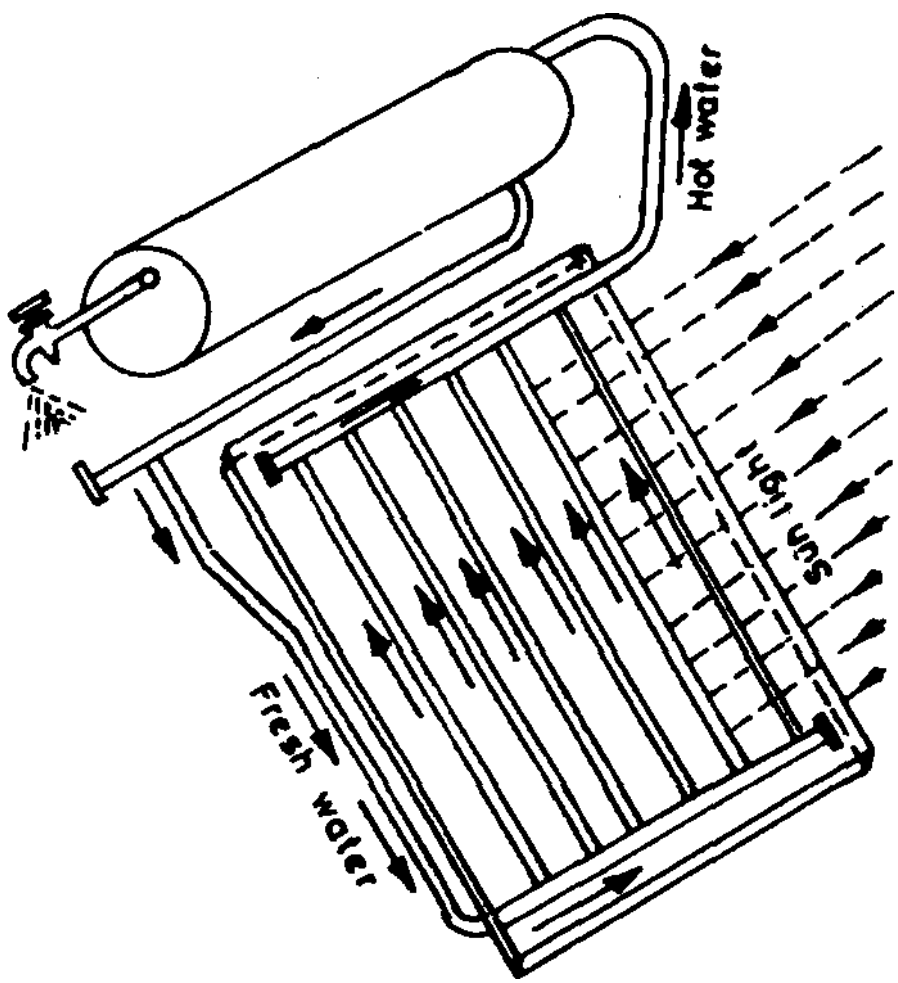
The infra-red rays present in the sun light are trapped inside the box, as they are not allowed by the box to go outside. They produce heating effect and temperature inside the box rises to 100°C and the food kept inside the containers is cooked.

Q. 6. Mention any two differences between a box type solar cooker and one with a spherical reflector. **[NCERT, Q. 5]**

Ans.

Box type solar cooker	*Spherical reflector type solar cooker*
1. These Cookers are not used for baking and frying.	1. These cookers are used for baking and frying because intense heating is possible.
2. No spherical or a parabolic reflector is used in these cookers	2. These cookers comprise a spherical or a parabolic reflector.

Q. 7. What is a solar water heater ? Draw a diagram of domestic solar heater and explain its working.



Ans. Solar heater is a device to supply hot water by using solar energy. It consists of an insulated water storage tank with an inlet for cold water and an outlet for hot water. The cold water is passed through a pipe fitted with a collector. The air that is warmed up inside the solar collector can be used to heat water.

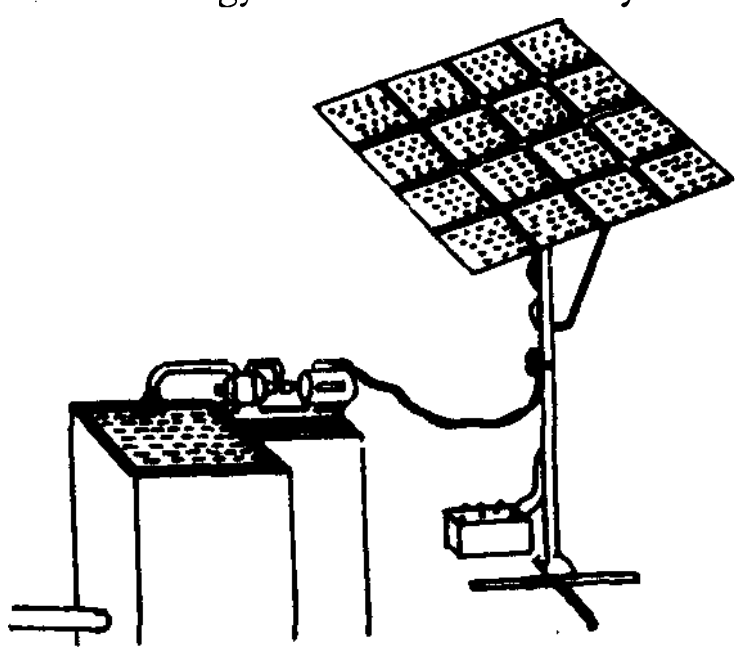
A sheet of corrugated metal is placed inside the box and water is fed through the pipe at the top. The metal is heated by the hot air and sun light, the water trickles slowly down the corrugations in the metal and gets warm. By circulating the water over the corrugated metal throughout the day the water becomes hot enough to proude the family's hot water needs.

Q. 8. Name the elements which can be used to fabricate a solar cell. **[NCERT, Q. 6]**

Ans. Now-a-days solar cells are fabricated from semi-conductor materials like silicon and germanium.

Q. 9. What are solar cells ? Explain their working.

Ans. A solar cell is a device which directly converts solar energy *i.e.*, radiant energy of sun into electricity.



Solar cell panel

Solar cells are usually made from semi-conductor materials like silicon and galium. Semi-conductors are materials which ordinarily do not allow current to pass through them, that is they are not good conductors. But unlike an insulator they allow some current to pass through them. However the conductivity of the semi-conductors increases considerably if certain impurties are added to them.

The conductivity of the semi-conductors also increases when light falls on them. In a solar cell, the pieces (usually wafers) of semi-conducting materials containing impurties are so arranged that a potential difference develops between two regions of a semiconductor when light falls on it. The current produced by a single cell measuring about 4 cm^2 may be of the order of 0.4 – 0.5 V at 60 milliampere (mA). A solar panel comprises a large number of solar cells and can provide much higher power for many uses.

Q. 10. Explain why solar cells has gained so much importance in last few decades. **[NCERT, Q. 7]**

Ans. Solar cells has gained so much importance in law few decades for the following reasons.

(i) The use of solar cells has been found very effective in remote and isolated location.

(ii) All artificial satellites and space probes depends on electricity generated by solar cells.

(iii) Use of solar cells has been demonstrated for lighting, operating water pumps, radio and TV receivers.

Q. 11. What are the disadvantages of solar cells.

Ans. Following are the disadvantages of solar cells.

(i) The cost of installation is very high.

(ii) The conversion efficiency of solar cell is very low. It is of the order of 12–15%.

(iii) The power of a single solar cell is very low.

(iv) The direct current produced is to be converted into alternating current.

Q. 12. Traditionally the solar energy has been put into limited use only why ?

Ans. Every square metre of earth's upper atmosphere receives 1·36 kJ of energy per second. Of this only 47% that is approximately 0·64 kJ energy reaches every square metre of earth's surface in one second. Even this small amount of energy is not available uniformely. It also keeps on changing every day at a place besides changing from place to place during a day. It is for this reason that traditionally the solar energy has been put to limited use only.

Q. 13. State three factors which are mainly responsible for wind and explain what is wind energy ? [NCERT, Q. 8]

Ans. The three factors which are mainly responsible for wind are as follows.

(i) The sun rays are much stronger near the equator than in the polar regions.

(ii) As a result, the air in the equitorial regions becomes warm and rises up. The cooker air from polar regions moves in to replace it.

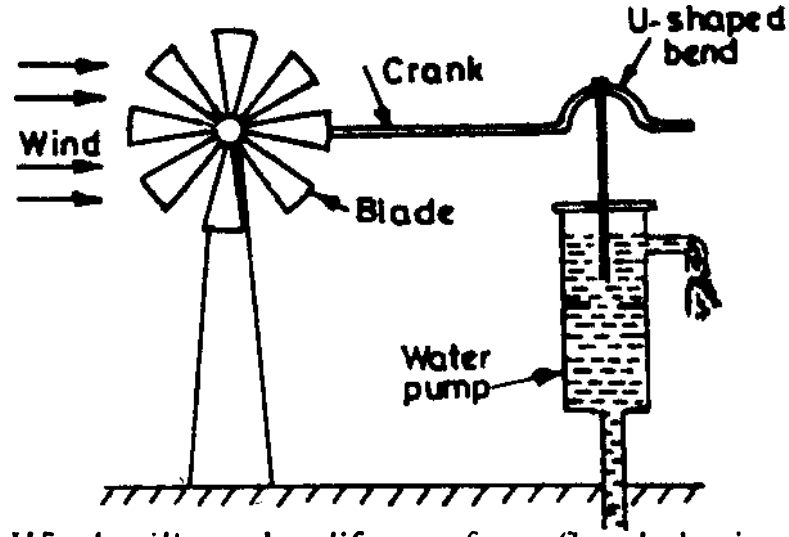
(iii) This flow of air gets continuously disturbed by the rotation of the earth as well as local conditions. The result is wind.

Moving air is called wind. The energy possessed by the wind is due to its high speed (or motion) that is the wind possesses kinetic energy.

Q. 14. Explain how wind-mills can be used to run a pump to draw water from the ground.

Ans. Wind Mills. Wind mills is a simple machine which works with the energy of flowing wind.

It is used to lift water from the ground or from flooded mines. Moving wind rotates the huge blades of wind mill. These rotating blades rotate crank (A crank is a rod having a U-shaped

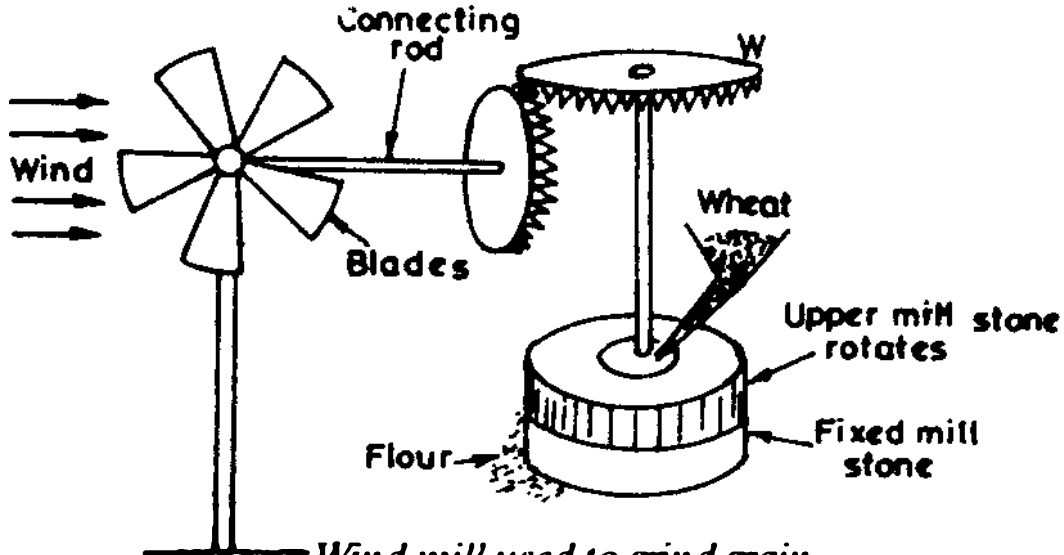


Wind mill used to lift wter from flooded mines.

bend which converts the rotatory motion into up and down motion). The U-shaped bend of the crank is connected to the rod of water pump which moves up and down as crank rotates as shown in fig. The up and down motion of pump rod lifts water from ground or flooded mines.

Q. 15. Explain how wind mill is used to grind grains ?

Ans. Wind energy is also used to run flour mill and to grind



Wind mill used to grind grain.

grains. Figure shows the arrangement of wind mill used to run flour mill. Moving wind strikes the blades of wind mill and rotates it. These rotating blades rotate a connecting rod and a wheel having teeth. These teeth form a coupling with teeth of an-

other wheel W, which also rotates and this rotating wheel W rotates the upper mill stone. However the lower mill stone remains fixed. Wheat which comes in between two mill stones is crushed into flour which comes out of the edge of the mill stone.

Q. 16. Mention various uses of wind energy.

Ans. The wind energy is used :

(i) to run wind mill to lift water from flooded mines and under ground.

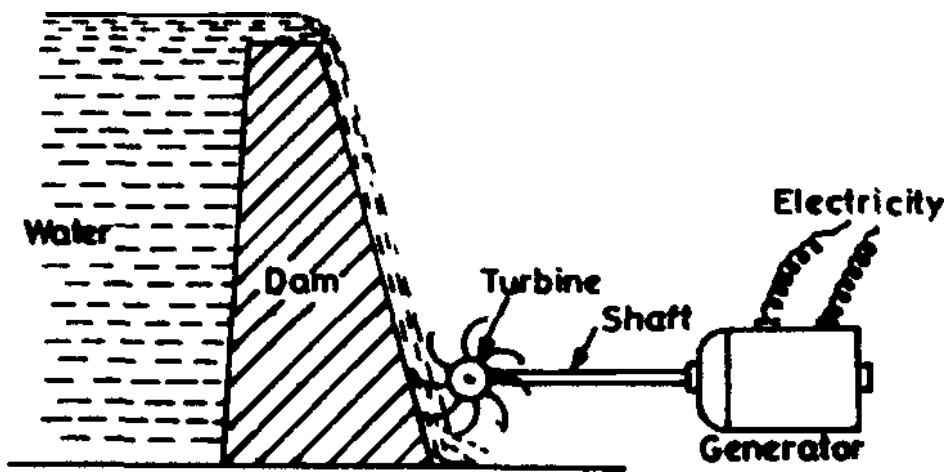
(ii) to run flour mills for grinding grain.

(iii) to generate electricity.

(iv) to propel the sail-boat in river in desired direction by using two sails boat, to transport men and materials.

Q. 17. Explain the basic principle of generation of hydro-electricity. **[NCERT, Q. 9]**

Ans. The electricity generated by using the energy of flowing water is known as hydro-electricity power. The energy of flowing rivers is stored behind dams as potential energy. The water is then allowed to fall from height over the turbine (water wheel) which rotates the shaft. The shaft is connected to the armature of dynamo (or generator) which produces electricity.



Q. 18. What is the main limitation and advantages of water energy ?

Ans. The main limitation of water energy is that flowing water is not available in plenty every-where to run the water-wheels and to run the machines.

Important advantage of water-energy is that its use does not cause any pollution.

Q. 19. State the disadvantages of constructing dams for producing hydro-electric power.

Ans. Construction of dams results in a variety of ecological changes in the down stream region of the river on which it is constructed. A vast variety of flora and fauna and even human settlements get submerged in a dam. This may subsequently also cause irreversible damage to the flora and fauna and crops in the adjoining and down stream areas.

Q. 20. Name the forms in which energy is stored in oceans. Name any three forms which could be harnessed.

[NCERT, Q. 10]

Ans. The energy from the ocean is available in many forms. For example, there is always a temperature difference between the water at the surface and deeper levels. This difference at many places is of the order of $20^{\circ}C$. This form of energy is known as ocean thermal energy (OTE).

Another form is the energy associated with the wave. Waves, piled up by the wind, continuously rise up and down the shore lines. Besides tidal waves keep billion of litres of water in movement as they built up and recede twice a day.

The difference in concentration of salt where water form the different seas meet each other can also be utilized to obtain energy in usable form. This difference in salt concentration is referred to as salinity gradient. Sea vegetation or biomass is another source of energy. The vast sea weed plantation provide an endless supply methane fuel. The oceans are also a source of deuterium of heavy hydrogen atom.

Ocean thermal energy, wave energy and tidal energy could be harnessed.

2

WATER

Q. 1. What are the sources of water ? Give in detail.

Ans. The sources of water supply may be, generally, classified as :

(A) Surface waters. 1. *Rain water* is probably the *purest form* of natural water, since it is obtained as a result of evaporation from the surface water. However, during the journey downwards through the atmosphere it dissolves considerable amount of industrial gases (like CO_2, SO_2, NO, NO_2 etc.) and suspended solid particles – both of organic and inorganic origin.

2. *River water.* Rivers are fed by rain and spring waters. Water from these soures, flow over the surface of land, dissolves the soluble minerals of the soil and finally, falls in rivers. *In general, the greater the contact that water has with the soil, or the more soluble the minerals of the soils with which it has come in contact, the greater is the amount of dissolved impurities in river water.* River water thus contains dissolved minerals of the soil such as chlorides, sulphates, bicarbonates of sodium, calcium, magnesium and iron. River water also contains the organic matter derived from the decomposition of plants and small particles of *sand* and *rock in suspension.* Thus, river water contains considerable amounts of dissolved as well as suspended impurities.

3. *Lake water* has a more constant chemical composition. It usually contains much lesser amounts of dissolved minerals than even well water, but quantity of organic matter present in it quite high. The quality of water of some big lakes is so good that

hardly any treatment is needed for industrial uses.

4. *Sea-water* is the *most impure form* of natural water. Rivers join sea and throw in the impurities carried by them. Moreover, continuous evaporation of water from the surface of sea makes sea-water continuously richer in dissolved impurities. Sea-water contains, on an average, about 3·5% of dissolved salts, out of which about 2·6% is sodium chloride. Other salts present are sulphate of sodium ; bicarbonates of potassium, magnesium and calcium ; bromides of potassium and magnesium and a number of other compounds.

Note. Surface water, generally, contains suspended matter, which often contains the disease-producing (or pathogenic) bacteria. Hence, such waters as such are not considered to be safe for human consumption.

(B) Underground waters. A part of the rain-water, which reaches the surface of the earth, percolates into the earth. As this water journeys downwards, it comes in contact with a number of mineral salts present in the soil and dissolves some of them. Water continues its downwards journey, till it meets a hard rock, when it retreads upwards and it may even come out in the form of *'spring'*.

Spring and *well water* (or underground water), *in general, is clearer in appearance due to the filtering action of the soil, but contains more of the dissolved salts.* Thus, water from these sources contains more hardness. Usually, underground water is of high organic purity. Thus, such waters are comparatively safer and fit for use for human consumption. Some spring water contains colloidal sulphur and possesses medicinal value.

Q. 2. Name three types of impurities present in sea-water. How would you obtain pure water from sea-water ?

Ans. Impurities in sea-water : *(i)* Dissolved gases *(ii)* Dissolved salts and *(iii)* Suspended solids.

Pure water from sea water. Sea water is subjected to distillation in a flask, fitted with a condenser and a receiver. The dis-

tillate so-obtained is pure water, and has been obtained by condensing steam.

Q. 3. Name the salts presents in sea water.

Ans. Salts present in sea-water :

(1) Sodium chloride (NaCl).

(2) Magnesium chloride ($MgCl_2$).

(3) Magnesium sulphate ($MgSO_4$).

(4) Calcium sulphate ($CaSO_4$).

(5) Potassium chloride (KCl).

(6) Magnesium bromide ($MgBr_2$).

Q. 4. Write the chemical formulae of two substances which contain water of crystallization. [NCERT Q. 1]

Ans. *(i)* Copper (II) Sulphate $C_4SO_45 5H_2O$

(ii) Borax, $Na_2B_4O_710H_2O$

Q. 5. List the impurities present in rain water.

[NCERT Q. 2]

Ans. The rain water dissolves in it the gases such as oxygen, nitrogen and carbon dioxide present in the atmosphere. All these impurities are present in the rain water found on the earth. The rain water also brings down with it the smoke and dust particles presents in the atmosphere.

Q. 6. How can you remove suspended impurities from a sample of water ? [NCERT Q. 3]

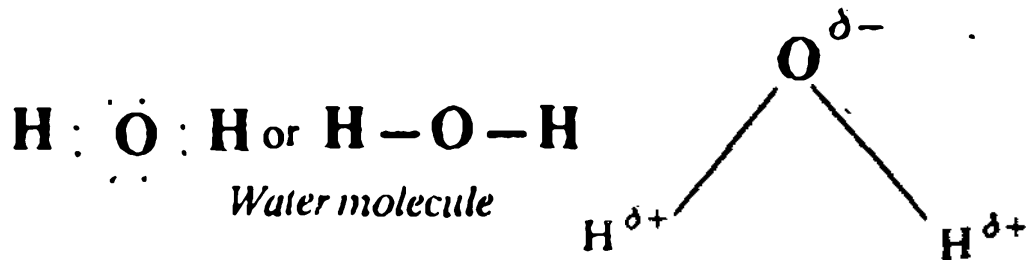
Ans. Suspended impurities in water can be separated by loading them.

Take 150 ml of a sample of water containing suspended impurities in a 250 ml beaker. Take a piece of alum, preferably large sized. Immerse it into the water in the beaker just below its surface and rotate it gently inside the water 3-4 times. withdraw the alum. After sometime, suspended impurities, which have been loaded with alum particles, start settling down at the bot-

tom of beaker. The turbidity caused by suspended impurities is removed. Decan this water into another 250 ml beaker with the help of a galss rod. The water is now clear

Q. 7. Draw a diagram of the structure of a water molecule. **[NCERT Q. 6]**

Ans. Water molecules are constituted of hydrogen and oxygen atoms. Oxygen is more electronegative than hydrogen. Therefore, in a molecule of water, each oxygen atom carries a small negative charge,



Structure of water molecule

represented by $\delta-$ (delta minus) and each hydrogen atom carries a small positive charge, represented as $\delta+$ (delta plus). The presence of positive and negative charges on oxygen and hydrogen atoms respectively makes water a polar substance. These hydrogen atoms can chemically bind themselves loosely with strongly electronegative atoms of many covalent compounds. These are called hydrogen bonds. Many covalent compounds such as sugar, urea, ammonia and alcohol dissolve in water due to this property.

Q. 8. Name some habitats which are provided to organisms by water. **[NCERT Q. 4]**

Ans. Sea water contains an abundance of algae, also called phytolanktons, fishes, turtles, snakes, crabs and marine mammals. The sea water provides food and dissolved oxygen and carbon dioxide in sufficient amount. The temperature variations in sea water are moderate and salts and minerals present in it suit

the organisms.

Q. 9. Describe the activity to show the polar nature of water. **[NCERT Q. 5]**

Ans. *Activity* : Take 50 ml water in a burette fixed vertically on a laboratory stand. Place a 250 ml beaker or any other container immediately beneath the jet of the burette and allow a stream of water to fall through the jet by opening the stop cock of the burette. Rub a piece of thermocol against a sheet of pater or flannel and take the rubbed edge of the thermocol near the stream of water. The stream of water molecules is deviated from its path. Sometimes it is attracted towards whereas sometimes it is repelled by the charged thermocol.

This activity shows the polar nature of water molecule *i.e.*, one end of a water molecule is positively charged whereas the other end is negatively charged.

Q. 10. Give three examples each of aqueous and non-aqueous solutions from daily life. **[NCERT Q. 6]**

Ans. Aqueous solutions : Solutions of *(i)* Sodium chloride *(ii)* Ammonium chloride and *(iii)* Copper sulphate.

Non-aqueous solutions : *(i)* solution of sulphur dissolved in carbondisulphide *(ii)* Solution of methane dissolved in carbon tetrachloride *(iii)* Solution of ethyne dissolved in acetone.

Q. 11. Why is it not possible to distinguish particles of a solute from a solvent in a solution? **[NCERT Q. 7]**

Ans. Solution is a homogeneous mixture having the same composition throughout. The soluble particles cannot be seen even with a microscope and the solute does not settle down even on keeping the solution for quite some time. If we filter the solution, the whole solution passes through the filter paper and no residue is left behind.

In a solution, the particles of the solute break up to such an extent that they disappear into the spaces between the solvent molecules. Thus, it is not possible to distinguish particles of a so-

lute from a solvent in a solution.

Q. 12. How will you prepare a saturated solution of potassium chloride at 30°C ? What will happen if this solution is allowed to cool ? [NCERT Q. 8]

Ans. Take 100 ml water in a 250 ml beaker at 30°C. Place it over a wire gauze kept on a tripod stand. Add one teaspoonful of potassium chloride and stir the solution. See whether if is dissolved.

Keep on adding one teaspoonful of potassium chloride each time, maintaining its temperature at 30°C and stirring the solution until the salt dissolves in the solution. After the dissolution of a few tea spoonfuls of potassium chloride, no more salt dissolves in the solution. This is the saturated solution of potassium chloride at 30°C.

When this saturated solution is allowed to cool, crystals of the solute start reappearing in the solution as it cools.

Q. 13. Define solubility of a substance. [NCERT Q. 9]

Ans. Solubility. The maximum amount of a solute that can be dissolved in 100 g of any solvent is called the solubility of that solute in that solvent at a specified temperature and pressure.

Q. 14. How is common salt prepared commercially from sea water ? Name the method by which the common salt obtained from sea water is purified. [NCERT Q. 10]

Ans. In a coastal areas, sea water is collected in small rectangle or square shaped lagoons. The water is then allowed to evaporate. After all the water has evaporated, crystals of common salt are left behind. Common salt obtained from sea water is purified by the method of recrystalization.

Q. 15.Name two fuels which are produced from water. [NCERT Q. 11]

Ans. Hydrogen and producers gas are the fuels produced from water.

Q. 16. Give the properties of water.

Ans. Physical properties. Physical properties of water (in pure form) include that :

(i) It is colourless, tasteless and odourless.

(ii) It boils at 100°C and freezes to ice at 0°C at normal pressure (760 mm Hg.)

(iii) Its molecules are polar.

(iv) Its density at 4°C is maximum (1.0000).

(v) It is found in all the three states in nature: solid, liquid, and gas.

(vi) It is a poor conductor of electricity.

Chemical Properties. Chemical properties of water (in pure form) include the following :

(i) It is neutral towards litmus *i.e.*, neither acidic nor alkaline.

(ii) It is decomposed (into hydrogen and oxygen) on passing a current of electricity (after making it a good conductor) by adding sulphuric acid or barium hydroxide.

(iii) It is stable to heat (even at 2000°C, it is very slightly decomposed).

(iv) It serves as a catalyst, for example ammonia and hydrochloric acid gas combine only in the presence of traces of moisture.

(v) It reacts with some metals (alkali metals-sodium, potassium, etc.) and releases great heat which burns the liberated hydrogen.

$$2Na + 2HOH \longrightarrow 2NaOH + H_2$$

(vi) Water of hydration or crystallization. It has been seen that crystals keep a fixed number of water molecules as a part of their constitution when crystallization takes place. Such water is called water of crystallization or water of hydration, and the substance is known as a hydrate *e.g.* $CaSO_4 \cdot 2H_2O$ (gypsum), $Al_2O_3 \cdot 2H_2O$

(bauxite), $Ba(OH)_2 \cdot BH_2O$ (barium hydroxide), etc. The hardening of cement and plaster of paris is due to hydrate formation.

Q. 17. What do you mean by Hard and Soft water ?

Ans. The water which does not readily forms lather with soap is called hard incontrast to soft water which readily forms lather with soap. Thus the soft water dissolves soap and produces lather while hard water is not capable to do this . Distilled water is cited as an example of soft water.

Q. 18. What are the causes of hardness ?

Ans. The hardness of water may be due to the presence of chlorides, sulphates and bicarbonates of calcium and magnesium. These chemical substances react with soap and make curdy white precipitates. Ordinarily the market soaps are made of sodium salts of higher fatty acids such as oleic acid ($C_{17}H_{33}COOH$), palmitic acid ($C_{15}H_{31}COOH$) and stearic acid ($C_{17}H_{35}COOH$). Thus the reaction can be shown as under :

$$\underset{\text{(found in hard water)}}{CaCl_2} + 2\underset{\text{(sodium stearate. soluble soap)}}{C_{17}H_{35}COONa} \longrightarrow 2Na + \underset{\text{(calcium stearate white precipitate)}}{(C_{17}H_{35}COO)_2Ca}\downarrow$$

$$\underset{\text{(found in hard water)}}{Mg(HCOO)_2} + 2\underset{\text{(sodium palmitate. soluble soap)}}{C_{15}H_{31}COONa} \qquad 2NaHCO_3 + \underset{\text{(magnesium palmitate, white precipitate)}}{(C_{15}H_{31}COO)_2Mg}\downarrow$$

The extent or degree of hardness of a water sample is defined as the number of parts by weight of calcium carbonate (or its equivalent) present in a million parts by weight of water. The extent or degree of hardness of water depends on the amount of soluble salts of Ca and Mg found in a certain volume of water.

Q. 19 Describe various types of hardness and how are they removed ?

Ans. Hardness of water which is of two types : Temporary

and permanent.

(i) Temporary hardness. The hardness of water which can be removed by easy means like boiling and which is due to the presence of soluble bicarbonates (hydrogen carbonates) of either calcium or magnesium or both is called *temporary hardness.*

(ii) Permanent hardness. The hardness of water due to the presence and magnesium and which cannot be removed by easy means like boiling is called *permanent hardness.*

Removal of water hardness. The removal of hardness of water is known as water softening. The methods to remove water hardness of temporary or permanent state are different.

To remove temporary hardness. This can be removed by following ways :

(a) By boiling. By boiling the soft water, the soluble bicarbonates lose and form carbonates. Carbonates being insoluble are removed by filteration or decantation.

$$Ca(HCO_3)_2 \xrightarrow{\text{Boiling}} CaCO_3 + CO_2 + H_2O$$

$$Mg(HCO_3)_2 \xrightarrow{\text{Boiling}} MgCO_3 + CO_2 + H_2O$$

(b) By Clark's method. Temporary hardness can also be removed by adopting Clark's method in which a calculated amount of milk of lime is added. By doing so soluble bicarbonates are changed to insoluble carbonates. Insoluble carbonates are settled down which later on are removed as discussed above.

$$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3 + 2H_2O$$

$$Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow MgCO_3 + CaCO_3 + 2H_2O$$

(c) By washing soda. Hard water added with washing soda cause settling down of insoluble carbonates which are removed by filteration.

$$Ca(HCO_3)_2 + Na_2CO_3 = CaCO_3 \downarrow + 2NaHCO_3$$

To remove permanent hardness. This can be removed by following methods :

(a) By adding soda ash. Permanent hard water is added with a calculated amount of soda ash (washing soda), calcium or magnesium salts are precipitated as carbonates :

$$CaSO_4 + Na_2CO_3 = CaCO_3 \downarrow + Na_2SO_4$$

(Soda ash)

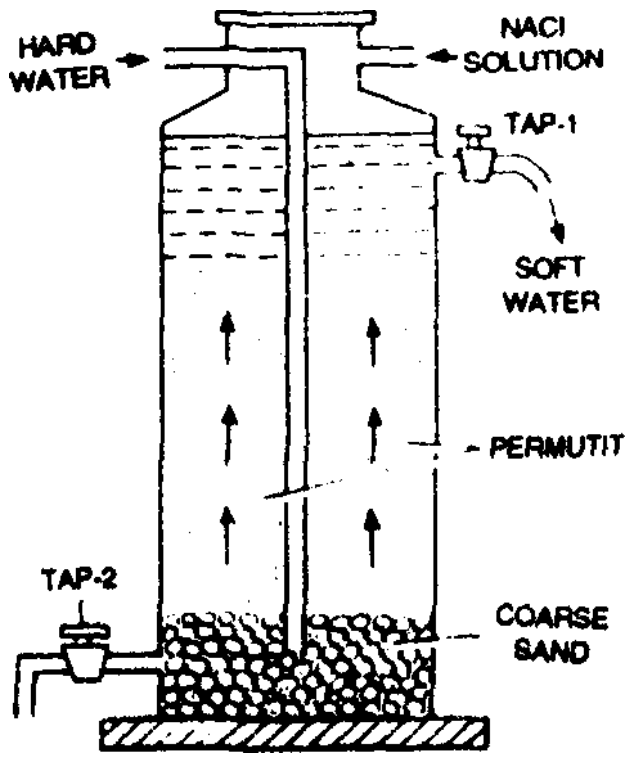
If hard water also contains magnesium sulphate, then lime is also added in addition to soda ash because magnesium carbonate is not fully precipitated :

$$MgSO_4 + Na_2CO_3 + Ca(OH)_2 = Mg(OH)_2 \downarrow + CaCO_3 + Na_2SO_4$$

Magnisium carbonate is more soluble than magnesium hydroxide $(Mg\ OH)_2$.

This method is used for domestic purpose *i.e.*, at small scale.

(b) By permutit process. Permutit is an artificial zeolite which is chemically a hydrated sodium aluminium orthosilicate, with the formula $Na_2\ Al_2\ Si_2O_8$ (also called sodium zeolite). This is obtained in the form of a coarse sand by fusing together sodium carbonate (Na_2CO_3), alumina (Al_2O_3) and silica (SiO_2). In this process permanent hard water (containing Ca and Ma salts) is allowed to percolate through zeolite lumps and in this exchange of ions takes place. The sodium permutit gets slowly changed into calcium and



Permutit Process to Remove Water Hardness

magnesium permutit. With the removal of Ca and Mg ions the water is softened and is released from the Tap.

$$Na_2Al_2Si_2O_8 + CaCl_2 \longrightarrow Ca(Al_2Si_2O_8) + NaCl$$

Sodium zeolite — In the incoming water — Calcium zeolite — [in the outgoing water (soft)]

When permutit is exhausted (approx. after 21 h), it is regenerated by running a concentrated solution of brine (10% NaCl) over it and removing the calcium chloride formed by repeated washing.

$$CaAl_2Si_2O_8 + 2NaCl = Na_2Al_2Si_2O_8 + CaCl_2$$

The washing are discharged through the Tap T_2.

This method is satisfactory for laundries and boilers.

(c) By calgon process. Calgon is the common trade name of a complex salt which is chemically called sodium hexa-meta-phosphate with chemical formula $(NaPO_3)_6$ or $Na_2(Na_4P_6O_{18})$ or $Na_2[Na_4(PO_3)_6]$. Use of calgon besides preventing the soap precipitation as Ca salts of higher fatty acids also dissolves such soaps. This method is used in softening water for boiler use.

(d) By ion exchange resins. By this method all minerals are removed and the resultant water bears no ions and hence can be used in place of distilled water. In this method water is passed through a tank partly filled with the granules of resin X which removes positive ions (Ca, Mg). This water is further passed through another resin Y which absorbs negative ions and thus water is demineralized. Resin X is made of organic molecules arranged in form of porous framework with acidic groups. Resin Y is made of grains of giant molecules with basic groups.

Q. 20. What are the disadvantages of hardness of water ?

Ans. Hard water has following disadvantages :

(i) In domestic use. It is very common to note that vegetables and pulses do not cook well in hard water. White incrusta-

tion is developed in cooking utensils and this causes wastage of fuel and cleansing powder. Lustre of utensils is also spoiled. While taking bath in hard water with soap, skin becomes dry and leaves white residue of soluble salts all over the human body. Soap is wasted not only in bathing in hard water but also when this water is used for laundry purpose Clothes also get yellow strain due to the presence of iron salts in hard water. This water is also not drinkable.

(ii) In industrial use. Various industries such as printing textiles, dyeing sugar, etc., consume large amounts of water. Therefore if the water is hard, the such industries products are harmed in the form of producing impure shades and prints on the cloth, spots on the cloth, blackening of sugar, etc. Due to the presence of iron in hard water dyeing and printing become unfit because it produces insoluble lakes with dyes, responsible for impure shades and cloth prints.

(iii) In boiler use. Hard water is generally strictly prohibited to be used because of loss of heat, corrosion, foaming and danger of explosion.

Q. 21. What are the advantages of hardness of water ?

Ans. Use of hard water has following advantages :

(i) Hard water being dissolved with minerals or salts is used in breweries for the preparation of special wines and other beverages. Very soft water on the other hand is tasteless and hence not liked for drinking purposes. Minerals or salts dissolved in hard water improve the taste and therefore, water is preferred to be used in breweries.

(ii) Since small amounts of calcium and magnesium are needed for our body building and growth, therefore very soft water should not be used for drinking purposes.

(iii) It is true that soft water dissolves lead from lead pipes more readily than hard water to form poisonous lead salts.

Q. 22. Describe various uses of water. [NCERT Q. 13]

Ans. Uses of water :

(i) The main use of water is for drinking.

(ii) Water is used for washing clothes, bathing and cooking and for many other purposes in daily life.

(iii) Water is used for construction purposes and generation of steam in industrial boilers.

(iv) Water is used for irrigation through large irrigation canals.

(v) Water is used for production hydro-electricity by moving the trubines and also for producing steam for generating electric current in thermal power plants and nuclear power plants.

(vi) Water is used as a solvent in many industrial processes.

(vii) Water is used as a coolant in the radiators of cars and lorries.

(viii) Some fuels, such as hydrogen, and producer gas, which uses steam are made from water.

Q. 23. Define the term solution.

Ans. A solution may be defined as a *perfectly homogeneous mixture obtained by mixing pure substances.* The terms **solute** and **solvent** are commonly used in solutions. *The solvent being the substance present in excess, i.e., the solvent does the dissolving ; while the solute is dissolved.*

Example : A solution of sugar in water.

Q. 24. Define the terms solute and solvent of a solution.

Ans. Solute and solvent. Every solution consists of two constituents – the solute and the solvent. *The constituent that dissolves another substance or the constituent that forms the continuous medium, is called the* **solvent** ; *while the constituent that is dissolved or dispersed, is called* **the solute. Thus, we can say that the solvent does the dissolving, while the solute is dissolved. In most cases, the solvent being the substance presence in excess.**

However, in case both the constituents are present in equal amounts, the component having physical state similar to that of the resulting solution is taken as solvent. For example, 100 g of water at 60°C can dissolved 110 g of potassium nitrate. Here *water is a liquid and the solution formed is also a liquid*. Hence, in this case *water is a solvent*, although its amount present is less than that of the solute, potassium nitrate.

Q. 25. What are the characteristics of solution ?

Ans. Characteristics of a solution : (1) A true solution, also called as molecular solution, is homogeneous mixture of two or more substances. For example, salt solution in water, sugar solution in water.

(2) The particles of a solution are of molecular size, *i.e.*, their diameter is in the range of 10^{-8}cm.

(3) In a true solution, we can not distinguish between the particles of solvent and the solute, since they are homogeneously mixed.

(4) Solutions are, generally, transparent.

(5) Solution is stable and its solute does not settle on standing.

(6) The solute particles of a solution can pass through filter paper.

(7) The solute particles of a true solution are so small that they cannot be seen even by a powerful microscope.

Q. 26. Explain the terms

(i) **Solubility of a solid**

(ii) **Saturated solution**

(iii) **Unsaturated solution**

(iv) **Super-saturated solution.**

Ans. *(i)* **Salubility of a solid** *(or salt) at a given temperature in a given solvent is the maximum weight of the solid (or salt) in grams which can dissolve in 100 g of the solvent.* In other words, it is the number of grams of solute (or solid salt) which dissolves in

100 g of the solvent to form a saturated solution at the given temperature. Solubility is expressed in grams.

(ii) A salt solution is said to be **saturated solution** *when no more of the salt (or solute) dissolves in a given amount of the solvent at a given temperature* (room temperature in the *present case*) *in presence of excess of the salt (or solute).*

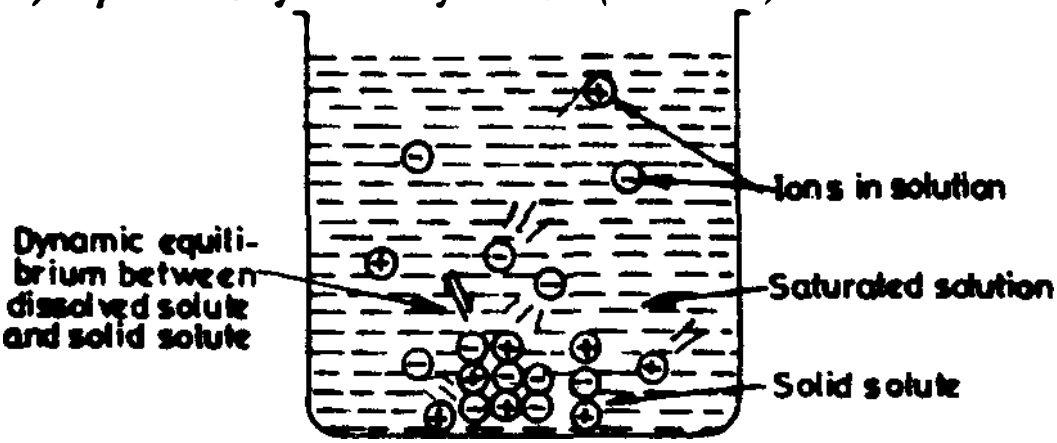


Fig. In a saturated solution, there is a dynamic equilibrium between dissolved solute and solid solute.

(iii) An **unsaturated solution** *is one, which can dissolve a part of the added solute, at the given temperature.*

(iv) A **super-saturated solution,** *when allowed to stand gives our some of the solute from the solution.*

Q. 27. Give main points of difference between true solution and colloidal solution.

Ans.

	True solutions (e.g. NaCl in water)		*Colloidal solutions (e.g., milk)*
(1)	*Nature of system.* Homogeneous.	(1)	Hetrogeneous.
(2)	*Size of dispersed particles.* Molecular dimension, *i.e.*, 10^{-10} to 10^{-9} m.	(2)	Size varying between 10^{-9} to 10^{-7} m.

(3)	*Visibility.* Particles are invisible under all circumstances.	(3)	Particles can be viewed through an ultra-microscope, but they are invisible even under most powerful microscope.
(4)	*Diffusion.* Diffuse readily.	(4)	Diffuse very slowly.
(5)	*Filtrability.* Can pass through filter paper as well as parchment membrane.	(5)	Can pass through filter paper, but not through parchment membrane, due to the large size of colloidal particles.
(6)	*Electrophoresis.* Do not exhibit.	(6)	Exhibit.
(7)	*Tyndal effect.* Do not exhibit.	(7)	Exhibit.
(8)	*Brownian motion.* Do not exhibit.	(8)	Exhibit.
(9)	*Co-agulation.* Can not be easily co-agulated.	(9)	Can be co-agulated by adding electrolytes or oppositely charged sols.

Q. 28. Compare the characteristics of solutions, colloidal solution and suspension.

Ans.

Property	*Solution*	*Colloidal Solution*	*Suspension*
1. Particle size.	The solute particles have sizes less than 10^{-9} m.	The colloidal particles have sizes between $10^{-9} - 10^{-6}$ m.	The suspended particles have sizes greater than 10^{-6} m.
2. Type of Mixture.	Homogeneous.	Heterogeneous.	Heterogeneous.

3. Examples.	Common salt in water, sugar in water, alcohol in water, sulphuric acid in water, sodium hydroxide in water, silver nitrate in water, iodine in carbon tetrachloride.	Milk, writing inks, smoke, white of an egg, butter, Jellies, foam, blood, gum, rubber solution, aerosols etc.	Muddy water, sand in water, wood-particles in water, salt in benzene.
4. Visibility of particles.	Particles are not visible with the naked eye and not even with the microscope.	Particles are usually not visible with the naked eye except gaseous colloidal solutions as smoke particles in air. Can be seen with microscope.	Particles usually visible with the naked eye.
5. Physical appearance.	Clear and transparent.	Clear but transluscent.	Opaque
6. Stability.	Stable	Stable	Particles settle down to the bottom.

Q. 29. What is meant by the terms

***(i)* Colloidal solution and *(ii)* Suspension ?**

Ans. *(i)* Colloidal solution. A colloidal solution or sol is a "two phase hetrogeneous system in which a substance (solid, liquid or gaseous) is distributed in colloidal state (*i.e.*, of diameter between 1 to 100 mm) in an insoluble medium (solid, liquid or gaseous)." The particles of the dispersed substance of colloidal size (or internal phase), are called *dispersed phase* ; while the insoluble medium (or exter . . . phase) in which they are dispersed, is called *dispersion medium.*

Examples : Soap solution in water, milk, smoke, ink, etc.

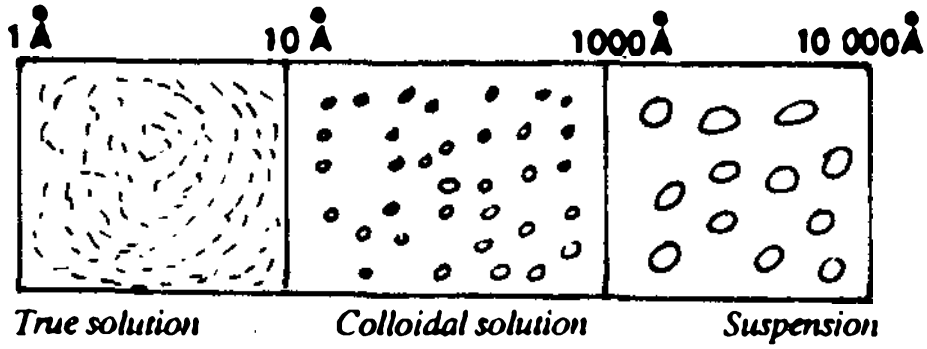
(ii) **Suspension** *is a hetrogeneous mixture of two (or more) substances such that the size of the dispersed particles is* 10^{-5} *cm or larger.* For example, muddy river water, suspension of sand in water.

Q. 30. How do particle size vary for

***(i)* True solution *(ii)* Colloidal solution and *(iii)* Suspension ?**

Ans.

True solution	*Colloidal solution*	*Suspension*
10^{-9} to 10^{-10} m	10^{-7} to 10^{-9} m	Above 10^{-7} m



Q. 31. Mention important characteristics of colloidal solution.

Ans. Characteristics of a colloidal solutions : *(i)* The size of the dispersed particles is in the range 10^{-9} to 10^{-7} m.

(ii) The dispersed particles of a colloid do not settle down (or separate out) on keeping, *i.e.*, it is a stable dispersion.

(iii) It is hetrogeneous in nature, *i.e.*, its composition is not uniform throughout.

(iv) The particles of a colloid can pass through a filter paper.

(v) The particles of a colloid can be seen only with a high power ultramicroscope (*i.e.*, a microscope with dark background).

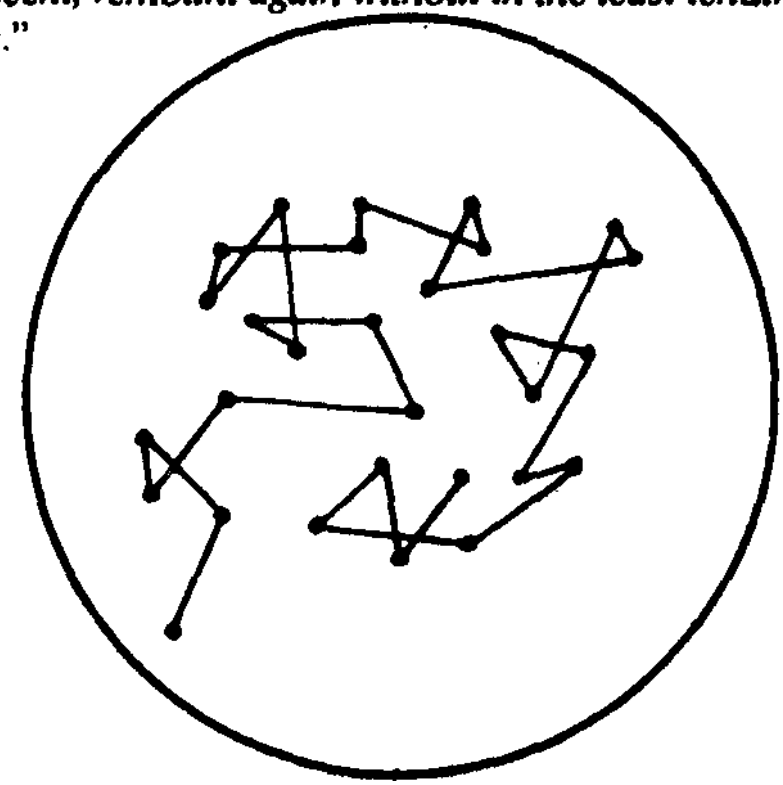
Q. 32. Explain the terms

(i) **Brownian movement**

(ii) **Tyndall effect**

(iii) **Electrophoresis**

Ans. ***(i)*** **Brownian movement.** *When a colloidal solution is examined under an ultramicroscope, the colloidal particles are seen to be in a state of continuous, rapid, random motion.* This phenomenon was first noticed by Robert Brown, an English botanist, in 1827 and hence, is called the "**Brownian movement.**" *This motion is found to be independent of the nature of the colloid, but is more rapid in case of particles of smaller size and in less viscous dispersion medium.* This complete erratic zig-zag motion is described by Perrin as : "*They go and come, start again, mount, descent, remount again without in the least tending towards immobility.*"

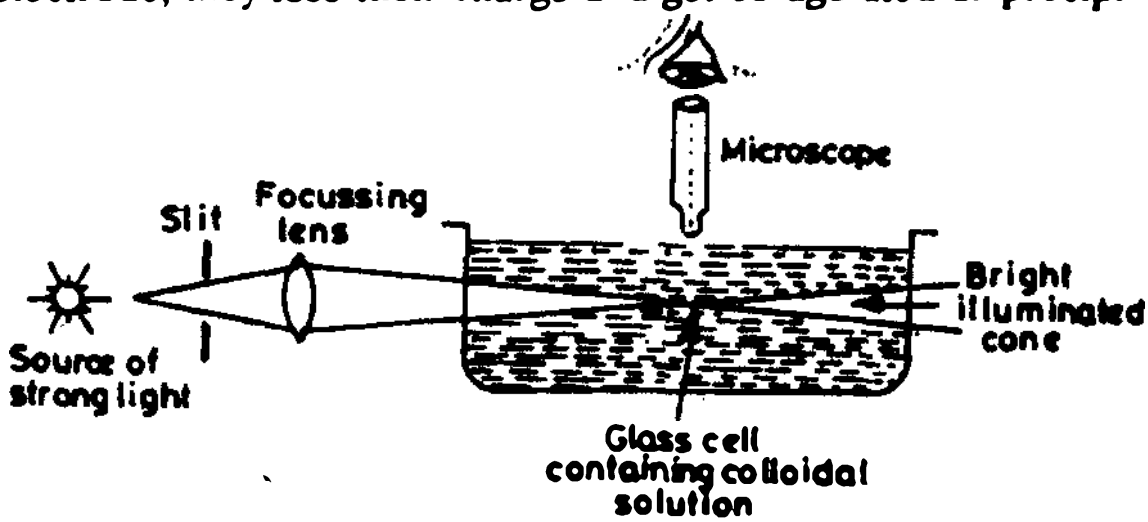


Brownian movement exhibited by colloidal particles

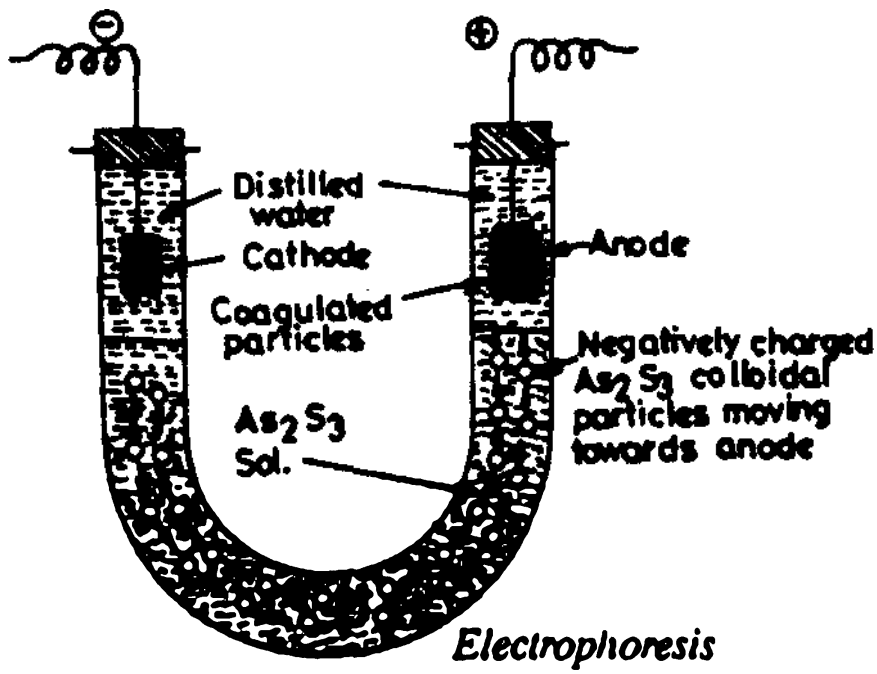
(ii) **Tyndall effect.** If a powerful beam of light is passed through a colloidal solution (contained in a glass cell) placed in a dark room, the path of the beam becomes visible, when viewed

through a microscope placed at right angles to the path of light. *The colloidal particles appear as pin-points of light moving against the darkground.* This phenomenon, is known as **Tyndall effect.**

(iii) **Electrophoresis.** *Colloidal particles are electrically charged, either positively or negatively.* When a high potential gradient is applied between a U-tube, filled partly with a colloidal solution and rest with distilled water, the colloidal particles move towards oppositely charged electrode. On reaching the electrode, they lose their charge and get co-agulated or precipi-



Tyndall effect exhibited by a colloidal solution



Electrophoresis

tated. *The movement of the colloidal particles under the influence of electric field*, is known as **electrophoresis.**

Q. 33. Classify the following into solutions, colloids and suspensions.

***(i)* Soda water, *(ii)* Muddy water, *(iii)* Gum, *(iv)* Sugar solution in water, *(v)* Ink, *(vi)* Blood, *(vii)* Milk, *(viii)* Brine, *(x)* Salt in alcohol, *(xi)* Smoke.**

Ans. *Solution* : Soda water ; sugar solution in water ; brine.

Colloids : Gum ; ink ; blood ; smoke.

Suspension : Muddy water ; salt in alcohol.

3

AIR

Q. 1. What are the different components of air ?

[NCERT Q. 1]

Ans.

Component	*Amount (% by volume)*
Nitrogen	78·1
Oxygen	20·29
Carbon dioxide	0·033
Water Vapour (H_2O)	0·4 (Variable)
Inert gases	0·95
Dust Particles	Variable

Q. 2. What will happen if the amount of oxygen is increased in the air ? **[NCERT Q. 2]**

Ans. If the amount of oxygen is increased in the air then the rate of Combustion in our bodies would be too rapid to sustain life.

If burning took place in the air having increased amount of oxygen, fires would be too intensely hot and uncontrolable.

Q. 3. How will you prove that air is a mixture of different gases. **[NCERT Q. 3]**

Ans. Air is a mixture of different gases because of the following reasons :

(i) Air can be separated into its constituents like oxygen, nitrogen etc. by the physical process of fractional distillation.

(ii) Air shows the properties of all the gases present in it.

(iii) Air has a variable composition because air at different places contains different amounts of the various gases.

(iv) Air has no Characteristic property of its own. Its physical properties are the average properties of a mixture of nitrogen and oxygen, *e.g.* the density of air is intermediate between the densities of nitrogen and oxygen.

(v) When Components of air, as they occur (4 parts of nitrogen with 1 part of oxygen) are mixed together, there is neither evolution nor absorption of heat. This is the Characteristic of a mixture and not a Compound.

Thus it can be concluded that air is a mixture of different gases.

Q. 4. What will happen if ozone cover of the atmosphere is removed ? **[NCERT Q. 4]**

Ans. If ozone cover of the atmosphere is removed, then all the harmful ultra violet radiations coming from the sun would reach the earth. These ultra-violet radiations would cause skin cancer in men and animals and also damage the plants. All the life on earth would then be gradually destroyed.

Q. 5. Define particulate matter. Name five particulate matters present in the air.

Ans. Particulate matter. The finely divided solid or liquid particles suspended in air are called particulates. The particulates are a kind of pollutants in the air. Examples of particulates in the air are :

(i) **Aerosol.** Very minute solid and gas particles dispersed in gaseous medium forming cloud are called aerosols : *Examples* : Smoke, fog.

(ii) **Dust.** A solid of very small size suspended temporarily

in air is called dust. These particles do not disperse but after sometime settle down due to force of gravity

(iii) **Dooplet.** A small structure and density of liquid particle which can fall down when the air is still but it remains suspended in turbulent condition.

(iv) **Flyash.** Due to the combustion of fossil fuels, ash along with gas is produced which form the fly ash. This ash also Contains partially burnt particles.

Examples : Coal ash and the ash coming out from a boiler.

(v) **Fog** : Condensed water vapour suspended in air near the surface of the earth.

Q. 6. How does nature maintain a balance between the carbon dioxide and oxygen. **[NCERT Q. 6]**

Ans. The major suppliers of carbon dioxide to the atmosphere are Volcanoes and living organism. Volcanoes release carbon dioxide gas from the interior of earth whereas living organisms release carbon dioxide gas during their respiration and decay. Burning of fossil fuels like coal, petroleum and natural gas release carbon dioxide into the atmosphere.

The major Consumers of carbon dioxide from the atmosphere are the green plants and oceans. The green plants use carbon dioxide of atmosphere to prepare food by the process of photosynthesis, whereas the water of oceans dissolves carbon dioxide of atmosphere to form Carbonate rocks.

In this way, both the atmosphere and oceans continuously exchange the carbon dioxide with the rocks, plants and higher organism. Thus nature maintains a balance to carbon dioxide and oxygen.

Q. 7. Discuss what will happen if the amount of both Carbon dioxide and dust particles increases in the air.

[NCERT Q. 7]

Ans. *(i)* **Carbon dioxide.** If the amount of carbon dioxide in the air increases, then the atmosphere will get heated too much.

The excessive heat will melt glaciers and lead to the flooding of low lying areas of earth.

(ii) **Dust particles.** Dust particles Cause various allergic reactions, bronchial asthma, tuberculosis and other infections. This is because dust particles attack the respiratory track of men and animals and damage the tissues in the lungs.

Dust particles in the air reduce the amount of solar radiation reaching the earth and hence disturb the eternal balance of the earth.

Q. 8. Discuss the roles of plants in the environment.

[NCERT Q. 8]

Ans. Plants play a very important role in mainting the level of CO_2 and O_2 in the atmosphere through the process of photosynthesis and respiration.

Plants transpire Continuously, that is they lose water from their surface transpiration. Water vapour released during transpiration come in the atmosphere. These water vapours take up the heat from the atmosphere for evaporation. Thus during this process the temperature of the atmosphere tends to lower down.

Growing of trees along the road-side is not only useful for shade and timber but also serves as the noise limiters and conditioning the weather by purifying and humidifying the air. They also act as wind breapers, check heat radiations and obstruct glare from the sun and other sources of bright light.

Q. 9. Write short note on corrosion of metal.

[NCERT Q. 9]

Ans. Corrosion of metals is the show destruction of metals as a result of chemical attack by air, moisture and pollutants present in the atmosphere. During the process of corrosion the useful metals are oxidised by the present in the air in the presence of moisture to form metal oxide and metal hydroxide.

The two conditions necessary for the Corrosion of metals to take place are *(i)* presence of oxygen (of air) and *(ii)* presence

of moisture (or water) in air. The presence of pollutants in the air increases the rate of corrosion of metals. This is because air polluted with Smoke emitted by factories Contains acidic gases like sulphur dioxide, nitrogen dioxide and Carbon dioxide which corrode the metals even faster.

Q. 10. Define acidic gases. Give its examples. Can you observe its effect on newly constructed building built by marble ?

[NCERT Q. 10]

Ans. Gases which Combine with water vapour present in the air and form acids are called acidic gases. Examples are sulphur dioxide (SO_2) and nitrogen dioxide (NO_2).

When these gases come down on the earth along with rain water, the latter is called acid rain. Acid rain eats up the marble of the building and hence damage them.

Q. 11. How very small quantity of carbon monoxide Causes oxygen deficiency in blood. **[N.C.E.R.T. Q. 11]**

Ans. When Carbon monoxide combines with the haemoglobin of blood, it forms Carboxy haemoglobin. Even a very small amount of Carbon monoxide is sufficient to form Carboxy haemoglobin which adversely affects the oxygen Carrying Capacity of haemoglobin. Thus Carbon monoxide Causes oxygen deficiency in blood. The deficiency of oxygen in blood ray cause headache, dizziness, Cardiac and pulmonary charges and even death.

Q. 12. What are the harmful effects of lead and mercury ?

[NCERT Q. 12]

Ans. *(i) Harmful effects of lead.* The excessive level of lead in the tissues and blood of human beings causes a disease known as lead poisoning. The initial symptoms of lead are Nausea, Insommia, constipation, fatigue, abdominal pain and anamia. These are followed by muscular paralysis and mental disorders. Lead poisoning can even lead to permanent brain damage in children.

(ii) Harmful effects of mercury. Mercury poisoning causes a disease known as minamata in human beings. The mercury poisoning or minamata weakens the muscles an vision and hearing capacity are impaired (damaged). This is followed by brain damage leading to mental retardation and paralysis. The cripled person often becomes mad and then dies.

Q. 13. Write an essay on air pollution. **[NCERT Q. 13]**

Ans. Air pollution is an undesirable change in the physical, chemical or biological characteristics of air. This change may adversely affect human life and other species. Air pollution also affects raw materials, industrial processes, living conditions and cultural assets. The pollution sources of air pollution of air may be caused by natural processes, or human activities. The substances that pollute air are called 'pollutants' and are of various kinds. The gases and particulate matter released along with cave from volcanic eruptions, dust raised from the ground during storm and strong winds, smoke from forest fire and fog are some of the natural cause of air pollution. Apart from these, methane from march and the decomposition of plant and animal residue and pollen/grains also contribute to air pollution.

Carbon monoxide is toxic and decreases the Concentration of oxygen in blood stream by forming stable Carboxy hemoglobin. Increase in Concentration of carbon dioxide causes increase in temperature of the earth thus affecting the climate. Oxides of sulphur affect vegetation. Nitrogen oxides facilitate formation of photochemical smog and acid rains. Photochemical smog and particulate matter cause lung cancer. Radioactive substances released in traces into atmosphere from nuclear bomb testing or research establishment disrupt cell membrane and damage enzymes, genes and chromosomes.

Types of pollutants :

(i) Non-degradable pollutants. These are the pollutants which donot undergo decomposition in the natural ecosystem. Prolonged use of these pollutants ends in becoming Concen-

trated in the tissue system of animals though food, chain, especially in man, lions, tigers. These pollutants are very dangerous as they retain in ecosystem and tissue system for a very long period, *e.g.* DDT. Aldrin.

(ii) Bio-degradable Pollutants. These are those pollutants which are easily decomposed by decomposers like bacteria in the ecosystem. Important air pollutants are smoke, led, photochemical smog etc.

Q. 14. What is Radioactivity ? Name some of the sources of radioactive pollution. What will happen if a person is put under prolouged frequent exposure of radioactive substance ?

[NCERT Q. 14]

Ans. Radioactivity is a phenomenon of spontaneous emission of electrons (beta particles) and gamma rays (electromagnetic radiations) as a result of disintegration of atomic nuclei of some elements.

Sources of radioactive pollution. There exist both natural and man made sources of radioactive pollution. The natural sources are mainly the naturally occurring radioactive elements and their compounds, for example radium–224, uranium–235, uranium–238, potassium-40 and carbon–14 are some such elements which occur in rocks, soil and coater.

Some of the human activities such as mining and refining of plutonium and thorium, production and explosion of nuclear weapons, operation nuclear power plants and fuels used in them and preparation of radioactive isotopes may, result in radioactive pollution if air.

Prolonged and frequent exposure to radioactive substances can cause cancer and leukaemia and induce mutations. The mutated genes can persist in human, animal and plant populations and affect their pregrency.

Q. 15. What are the attributes of noise ? Name its unit of measurement what is the level of sound of conversation ? What are the measures to control noise pollution of source ?

[NCERT, Q. 15]

Ans. The attributes of noise are its loudness and duration. The unit of measurement of intensity of sound is called the decibel (dB). Human ear is sensitive to sound intensity ranging from 0–180 dB. The intensity of a normal conversation is 60 dB.

Measures to control noise pollution at source are :

1. Sources of noise pollution :

(a) Setting industries away from the dwelling areas

(b) Using better designed engines.

(c) Lubricating and maintaining the machines.

(d) Enforcing laws to get rod of the noise producing vehicles and the restricted use of loudspeakers and amplifiers.

2. Path of Noise :

(a) Planting of trees along the roads.

(b) Entercepting the path of sound by using various materials which absorb the sound. Accoustic materials and mufflers can also be used.

3. Receptive organs :

Using the ear muffs or cotton plugs.

Q. 16. Name the main layers from the surface of the earth upwards.

Ans. The main layers from the surface of the earth upwards are : *(i)* troposphere *(ii)* stratosphere *(iii)* mesosphere, and *(iv)* thermosphere.

Q. 17. What is ozone ? Where is ozone layer located and what is its importance ?

Ans. Ozone is a gas, a molecule of which is made up of three atoms of oxygen (O_3). The sunrays at a height of about 16 km from the earth convert the oxygen present these into ozone. The proportion of ozone increases upto 23 km. This height, the ozone layer is the thickest.

Ozone layer is very important for all living things. It ab-

sorbs the ultraviolet radiations emitted by the sun. The ultraviolet rays are very harmful to the living organisms. Ozone layer protects crops, climate and the health of human beings from many ill effects which would be caused by the ultraviolet rays. These radiations are of short wave length which can penetrate deep into our body. They destroy the organic molecules which are necessary for life and cause diseases like skin cancer.

Q. 18. State two ways in which carbon monoxide gas enters into the air.

Ans. *(i)* Carbon monoxide is produced by burning of fuels like wood, coal and oil in homes and factories.

(ii) The exhaust gases of automobiles engines like cars, buses, trucks and trains etc. also release carbon monoxide.

Q. 19. Give the effects of Carbon monoxide on human beings.

Ans. When we inhale polluted air containing carbon-monoxide, then this carbon monoxide readily combines with the haemoglobin of the formation of this compound, haemoglobin is unable to carry oxygen to the body parts. The lack of oxygen leads to the respiratory problems. Thus carbon monoxide poisoning causes suffocation and may even lead to death.

Q. 20. Give the adverse effects of carbon dioxide on living organism.

Ans. Adverse effects of Carbon dioxide :

(i) Carbon dioxide gas produces green house effect, leading the heating of the earth and its atmosphere. This will melt all the glaciers and therefore lead to the blooding of low lying coastal areas of the earth.

(ii) The excessive heat will damage the crop plants and reduce the agricultural production.

(iii) Due to excessive atmospheric temperature, the life of men and animals will become uncomfortable.

Q. 21. Give an activity to show that air contains water vapours.

Ans. Take a few pieces of ice in a tumbler. Observe the outer wall of the tumbler. After some time droplets of water will adhere to the walls. The water vapours present in the air condense on the cooler surface of the tumbler and get converted into water droplets. This activity shows that air contains water vapours.

Q. 22. What is the importance of carbon dioxide in the atmosphere ?

Ans. Importance of carbon dioxide in the atmosphere :

(i) Carbon dioxide gas produces green house effect, leading to the heating earth and its atmosphere, which is essential for our survival.

(ii) Carbon dioxide takes part in the photosynthesis to prepare food for plants and animals.

(iii) Carbon dioxide dissolves in oceans to form carbonate rocks.

Q. 23. Explain the role of trees and plants in controlling air pollution.

Ans. Plants and trees take carbon dioxide from the atmosphere for their food by photosynthesis. Thus, plants and trees reduce the excess, carbon dioxide in the atmosphere and maintain a balance in nature. At the same time, the plants and trees release oxygen into the atmosphere. Therefore, by growing more plants, our atmosphere will get rid of its excess carbon dioxide and pollution of air can be prevented.

Q. 24. Why the blanket of ozone in the atmosphere is very important ?

Ans. The ozone layer in the upper atmosphere is of great importance because it absorbs the harmful ultraviolet radiations present in sunlight coming from the sun. In this way, ultraviolet radiations are prevented from reaching the earth and we are

saved from their dangerous effects.

Q. 25. Carbon monoxide is a colourless and odourless gas and even then it is a pollutant. Why ?

Ans. Carbon monoxide is produced by man by the incomplete combustion of carbonaceous fuels and from the internal combustion engines. It is a highly poisonous gas because it reacts with the red pigment (haemoglobin) of blood to form a carboxyhaemoglobin. It is more stable than oxy-haemoglobin (combination of oxygen with haemoglobin) and thus transport of oxygen from the lungs to the tissues is impaired. This results in death. Oxyhemoglobin + Carbon monoxide ⇌ Carboxyhemoglobin + Oxygen. The effect of carbon monoxide poisoning can be removed if pure oxygen is inhaled immediately.

Carbon monoxide is a colourless, odourless and tasteless gas. Since its presence is not easily detected, its exposure can cause serious diseases and even death. Many deaths are reported in areas where people use *Angithis*. If the room is not properly ventillated, its concentration in air increases to the fatal level. People using *Angithis* should see to it that their rooms and kitchens are well-ventillated.

Q. 26. Give two methods for the prevention of corrosion of metals.

Ans. Prevention of corrosion :

(i) Corrosion of metals can be prevented by coating the metal with a protective layer of paint, varnish or grease. Iron can be protected from corrosion by giving a thin coating of another metal like zinc, tin or chromium which are easily corroded.

(ii) Some metals build up their own protective layer. For example, when zinc metal is exposed to atmosphere, it reacts with the oxygen of air to form a thin film of zinc oxide on its surface. This oxide layer protects zinc metal from further corrosion.

Q. 27. How air pollution can lead to corrosion of metals ?

Ans. Polluted air contains acidic gases like sulphur dioxide

and nitrogen dioxide. In the atmosphere, sulphur dioxide is converted into sulphuric acid and nitrogen dioxide is converted into nitric acid. These acids are washed down to earth with rain water causing acid rain. The dilute acids present in the acid rain corrode the metal gradually. For example, when the sulphuric acid present in acid rain reacts with iron. it forms iron (II) sulphate and hydrogen.

$$Fe + H_2SO_4 \longrightarrow Fe\,SO_4 + H_2$$

Iron (II) sulphate being soluble, peels off from the iron surface. Thus, the iron metal is slowly eaten up.

Q. 28. What is the effect of acidic gases on historical monuments ?

Ans. Several gases, such as sulphurdioxide (SO_2) and nitrogen dioxide (NO_2) present in the air cause harmful effects to buildings. These gases combine with water vapour present in the air and form respective acids. Therefore, these gases are called acidic gases, when these gases come down on the earth along with rainwater, the latter is called acid rain.

$$SO_3 + H_2O \longrightarrow H_2SO_4 \text{ (Sulphuric acid)}$$

$$NO_2 + H_2O \longrightarrow HNO_3 \text{ (Nitric acid)}$$

The effect of acid rain on the historical monuments or old buildings made of marble is a slow process. The effect of oxides of sulphur and nitrogen on old buildings is very slow and takes time to damage them.

$$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + CO_2 + H_2O$$

$$CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + CO_2 + H_2O$$

Q. 29. What is smog ? Why smog considered a health hazard ?

Ans. Smog. It is a combination of smoke and dust particles with the tiny droplets of fog containing poisonous gases discharged by the burning of fuels. The harmful gases present in Smog are sulphur dioxide and per oxyacyl nitrate (PAN).

Smog is considered a health hazard because it is harmful to all the organisms which breathe it. Smog causes respiratory complications like asthma attacks. Smog causes irritation to the eye, nose and throat.

Q. 30. Give two ill effects of smog.

Ans. Ill-effects of Smog :

(i) Smog reduces the visibility to a very low level causing the disruption of road and air traffic.

(ii) Smog causes irritation to the eye, nose and throat.

Q. 31. Give the ill effects of asbestos dust on human health.

Ans. Prolonged inhaling of asbestos dust by human being causes the disease 'asbestosis' and also lung cancer. Asbestos dust particles keep on depositing in the lungs and cause a progressive decrease in the functional capacity of lungs. The normally thin-walled alveoli and small bronchioles become thickened with fibrous asbestos tissue and the lungs lose their elasticity.

Q. 32. Give the effect of mercury poisoning on human beings.

Ans. Mercury causes minamata in human beings. This causes weakness of muscles and impairs hearing and eye sight. The mental retardation occasionally results in paralysis and death.

Q. 33. Give one major source of lead particulates in the urban air. Mention the ill effects of lead on human health.

Ans. The major source of lead particles in the urban air is due to the use of a tetraethyl lead as an antiknock in motor fuels like petrol.

Lead accumulates in considerable amount in the leaf tissues and also in the tissues of human body. It interferes with development and maturation of red blood corpuscles (RBC) in the

human body. Even 0·2 ppm of lead concentration may create metabolic disturbances. Prolonged exposure leads to stippled red blood cells. Being a cumulative poison, lead disrupts the functioning of cells and organs of the muscular circulatory and nervous system by getting bound with the cellular enzyme. It also causes coagulation of proteins. Besides damaging lever, kidney and intestine, lead also induces abnormalities in fertility and pregnancy.

Q. 34. Give four ill effects of particulate matter in air.

Ans. Ill-effects of particulate pollutants :

(i) The particulate pollutants cause allergic reactions such as bronchial asthma, tuberculosis etc.

(ii) Particulates reduce the visibility in the atmosphere.

(iii) The aerosol particulates like fog can absorb and concentrate poisonous gases and therefore cause more serious air pollution like smog.

(iv) Particulates in the air reduce the amount of solar radiation reaching the air and therefore disturb thermal balance of earth.

Q. 35. What is radioactive pollution ? How do radioactive material enter a food chain ?

Ans. Some of the radio-active materials such as uranium, thorium, radium and polonium disintegrate and emit radiations like alpha particles, beta particles and gamma rays. These radiations are a very serious pollutant of air, water and soil.

Radioactive substances get into the environment during the mining and processing of radioactive materials. Sometimes, accidents in nuclear reactors also put radioactive pollutants into the air, water and soil. From the soil and water, the radioactive materials can pass into the food chain of men and animals. For example, when crop plants are grown on contaminated soil, then the radioactive materials pass on to the crop plants. Now when the human beings or animals consume these plants or their prod-

ucts, then the radioactive materials get transferred to their body. Also, if the land contaminated with radioactive material is used for grazing cattle, then the radioactivity material goes into their body. The cattle will then give milk contaminated with radioactive materials. When human beings drink this contaminated milk, then the radioactive materials will be transferred to their bodies.

Q. 36. Name four important sources which causes radioactive pollution.

Ans. Sources of radioactive pollution :

(i) Processing of radioactive nuclear fuels for use in nuclear power plants.

(ii) Leakage from the reactor of nuclear power plants due to faulty construction or accident.

(iii) Disposal of nuclear wastes left behind in the nuclear power plant.

(iv) Radiation therapy for cancer.

Q. 37. Write two ill-effects of radioactive pollution.

Ans. *(i)* Low doses of radioactive pollution can affect all organisms seriously and impair their functions whereas high does may prove fatal.

(ii) Prolonged and frequent exposure to radioactive substances can cause cancer and leukaemia and induce mutations. The mutated genes can persist in human, animal and plant populations and may affect their progeny.

Q. 38. Give four effects on the local climate caused by the installation of heavy industries.

Ans. *(i)* Air pollution.

(ii) Rise in atmospheric temperature.

(iii) Change in humidity and

(iv) Ecological imbalance.

Q. 39. What is meant by corrosion of metals ? Explain with an example. What are the conditions necessary for corro-

sion ?

Ans. Corrosion of metals. It is the slow destruction of metals as a result of chemical attack by air, moisture and pollutants present in the atmosphere. During corrosion, the useful metals are oxidised by the oxygen present in the air in the presence of moisture to form metal oxide and metal hydroxide.

Example : Iron metal corrodes in the presence of air and moisture to form a brown coating of a mixture of iron (III) oxide and iron (III) hydroxide on its surface.

$$4Fe + 3O_2 + 3H_2O \longrightarrow Fe_2O_3 + 2Fe(OH)_3$$

The corrosion of iron is called rusting.

Corrosion of metal is an oxidation process in which electrons are transferred from the metal to oxygen. Water (moisture) acts as a transporting medium for these electrons. By losing electrons, the metal is converted into metal ions and forms the compounds which peel off from its surface leading to corrosion.

Conditions necessary for corrosion :

(i) Presence of oxygen of air.

(ii) Presence of moisture or water in air.

Q. 40. What is acid rain ? How is acid rain caused ? Give the ill effects of acid rain.

Ans. Acid rain. The burning of fuels produces acidic gases like sulphur dioxide and nitrogen dioxide. These acidic gases go into the atmosphere and pollute the air. In the air, sulphur dioxide is oxidised to sulphuric acid and nitrogen dioxide is converted into nitric acid. These acids are washed down to the earth with rain water. The rain water containing sulphuric acid and nitric acid in it is called acid rain.

Ill-effects of acid rains :

(i) Acid rain damages historical monuments. Acid present in the acid rain reacts with marble or limestone of buildings and corrodes it.

(ii) Acid rain increases the corrosion of metals like iron.

(iii) Acid rain increases the acid content of water bodies like lakes and rivers and damages a aquatic life.

(iv) Acid rain reacts with the nutrients present in the soil and leads to their removal from the soil.

(v) Acid rain damages the leaves of plants and trees.

Q. 41. What is noise pollution ? Give the important sources of noise pollution. Give the ill effects of noise pollution.

Ans. Noise pollution. This disturbance produced in the environment by the undesirable loud sounds of various kinds is called noise pollution.

Sources of noise-pollution :

(i) **In homes.** The sources of noise pollution are loudly played music systems like radios, stereos, televisions etc. Some people switch on their music systems at full volumes. This creates a lot of noise.

(ii) **In transport.** Road, rail and air traffic cause a lot of noise pollution in all the big cities. For example, the engines and horn of vehicles like scooters, cars in big city produces a lot of noise.

(iii) **In industries.** Factories and industries use machines which make noises of different types. Printing presses, textile factories etc. produce a lot of noise pollution.

Ill-effects of noise-pollution :

(i) Noise interferes in communication to other persons.

(ii) Noise increases nervous tension, blood pressure and heart trouble.

(iii) Noise causes headache and extreme emotional behaviour.

(iv) Noise disturbs peace of mind. It disturbs sleep as well as work.

Q. 42. Give the methods of preventation and control of

noise pollution.

Ans. The following three factors should be kept in view for controlling the noise pollution :

1. Sources of noise pollution :

(i) Setting industries away from the dwelling areas.

(ii) Using better designed enzymes.

(iii) Lubricating and maintaining the machines.

(iv) Enforcing laws to get rid of the noise producing vehicles and restricted use of loudspeakers and amplifiers.

2. Path of noise :

(i) Planting to trees along the roads.

(ii) Interrupting the path of sound by using various materials which absorb the sound. Accoustic materials and mufflers can also be used.

3. Receptive organs :

Using the ear muffs or cotton plugs.

Q. 43. How is the air polluting day by day. Give five reasons of increasing air pollution ?

Ans. The mixing of foreign materials other than the components of the air is known as the air pollution.

The five main reasons of increasing the air pollution air :

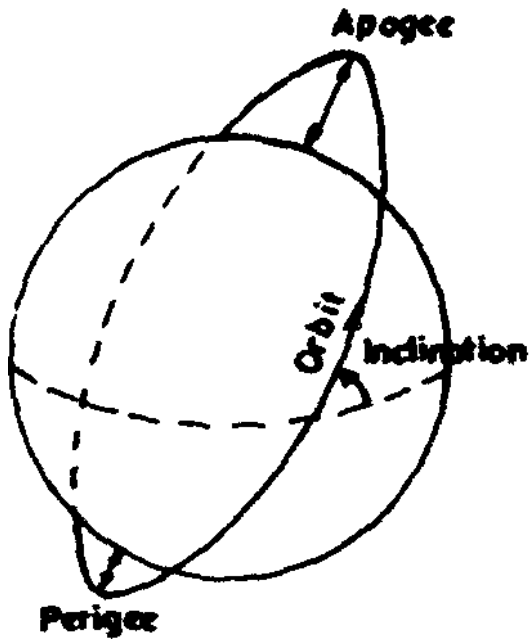
(i) Deforestation
(ii) Industrialisation
(iii) Population
(iv) Air traffic
(v) Stone crushers.

4

SPACE EXPLORATION

Q. 1. Name the characteristics which define an orbit of a satellite around the earth and show their position in a diagram. **[NCERT Q. 1]**

Ans. The closed path of a satellite around the earth is called its orbit. The orbit may be circular or elliptical in shape. The characteristics which define an orbit are apogee, perigee and inclination. Apogee is the farthest and perigee is the nearest point on the orbit of a satellite from the earth. The inclination of the orbit is determined by the angle it makes with the equator. *(See figure)*



Parameters of an orbit of the earth

Q. 2. State areas in which space technology findsits application. **[NCERT Q. 2]**

Ans. Applications :

(i) Space technology is used for making long distance Communications, like long distance telephone calls, television broadcasts and radio broadcasts. This is done by means of Com-

munication satellite stationed in outer space.

(ii) Space technology is used for Continuous weather monitoring and weather forecasting on the earth. This is done by using weather satellites stationed in outer space.

(iii) Space technology is used for the collection of information about other planets and outer space. This is done by sending the space probes.

(iv) Space technology is also used to study the world sources from outer space.

Q. 3. What are the sailent features of Indian space research programme ? **[NCERT Q. 3]**

Ans. Sailent features of Indian space research programme are :

(i) To develop expertise in planning, designing and fabricating the space craft (Satellites) for various purposes.

(ii) To develop suitable launching vehicles capable of placing the satellite in the earth's orbit.

(iii) To establish earth stations for launching, tracking, Controlling and guiding various functions of the satellites.

(iv) To develop a broad based ground segment for using space technology for mass communication.

Q. 4. Give names of the Indian Satellites launched from erstwhile USSR for remote sensing. **[NCERT Q. 4]**

S.No.	*Date of Launching*	*Name of Satellite*	*Result*
1.	19-3-1975	Aryabhatta	Success
2.	7-6-1979	Bhaskara-1	Success
3.	20-11-1981	Bhaskara-2	Success
4.	19-3-1988	IRS-1A	Success
5.	29-8-1991	IRS-1B	Success

Q. 5. Expand the following abbreviations :
APPLE, INSAT, IRS, ISRO and ASLV.

[NCERT Q. 5]

Ans. *(i)* **APPLE** : Ariane Passenger Pay Load Experiment
(ii) **INSAT** : Indian National Satellite
(iii) **IRS** : Indian Remote Sensing Satellite
(iv) **ISRO** : Indian Space Research Organization
(v) **ASLV** : Augmented Satellite Launch Vehicle.

Q. 6. When did India enter the space age ? Mention the aims of launching the first Indian satellite Aryabhata.

Ans. India entered the space age on 19 April, 1975 when the first satellite Aryabhata designed and fabricated in India was launched from erswhile Soviet Union. The satellite enabled Indian scientists to develop the skills and facilities for fabricating satellites and monitoring their performance in orbit. It also facilitate establishment of ground facilities for communicating with the satellite, tracking it and passing commands to it to carry out various tasks. Aryabhata also provided an opportunity to conduct some experiments in the fields of X-ray astronomy, solar physics and meteorology.

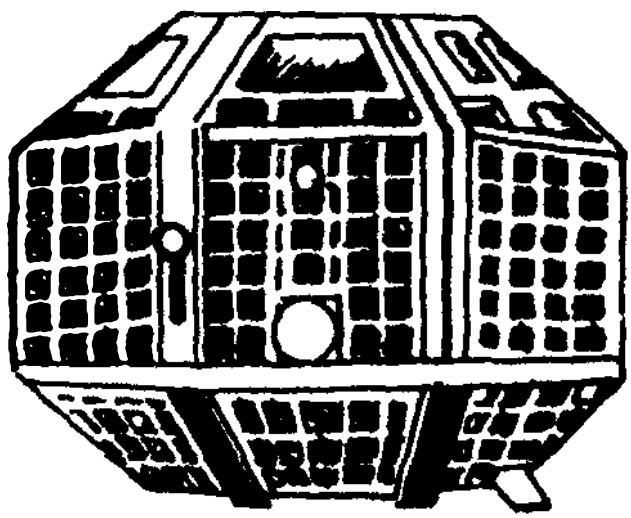


Fig. First Indian satellite, Aryabhata

Q. 7. Name the second Indian satellite and when it was launched what were its aims of launching ?

Ans. The Bhaskara-I was the second Indian satellite which was launched on 7 June, 1979 from Soviet Union. It was essentially intended to develop expertise in collecting data on natural resources through remote sensing techniques. Ground water

surveys, forestry and geological surveys were conducted through this satellite by collecting valuable data until March 1981.

Q. 8. Write a brief account of Indian Remote sensing satellite.

Ans. The first Indian Remote sensing satellite IRS-1A was launched on 17 March, 1988 while IRS-1B was successfully put into its orbit on 29 August 1991. Both these satellites were launched from erstwhile USSR.

In Gujrat-1A has enabled the tapping of water resources for drinking purposes.

Q. 9. Write a brief account of Indian satellite name as APPLE.

Ans. The APPLE is abbreviation of Ariane Passenger Pay Load Experiment. The satellite was launched on 19 June 1981 with the help of European Space Agency from the Kouron launching facility in French Guyana (South America). This was the first Indian satellite put in a geostationary orbit. The orbit of a satellite is called geostationary if the relative position of the satellite does not change with respect to a fixed station on the earth. In other words, the period of revolution of a geostationary satellite in its orbit is same as the period of rotation of the earth its axis, that is, 24 hours.

Q. 10. Give the main Events in India Space Programme.

Ans. Following are the main events in Indian space programme.

S. No.	Date of launching	Name of the Satellite	Name of the country which launched the satellite	Result
1.	19 March 1975	Aryabhata	USSR	Success
2.	7 June 1979	Bhaskara-1	USSR	Success
3.	10 August 1979	Rohini	India (SLV-3)	Failure
4.	18 July 1980	Rohini	India (SLV-3)	Success
5.	19 June 1981	APPLE	European Space Agency (ARIANE)	Success
6.	20 November 1981	Bhaskara-2	erstwhile USSR	Success
7.	31 May 1981	Rohini	India (SLV-3)	Failure
8.	4 September 1982	INSAT-1A	USA	Failure
9.	17 April 1983	Rohini	India (SLV-3)	Success
10.	30 August 1983	INSAT-1B	USA	Success
11.	24 March 1987	SROSS-1	India (ASLV)	Failure
12.	19 March 1988	IRS-1A	erstwhile USSR	Success
13.	12 July 1988	INSAT-1C	USA	Failure
14.	13 July 1988	SROSS-2	India (ASLV)	Failure
15.	12 June 1990	INSAT-1D	USA	Success
16.	29 August 1991	IRRS-1B	erstwhile USSR	Success
17.	19 May,1992	SROSS-3	India (ASLV)	Success
18.	10 July 1992	INSAT-2A	ARIANE	Success

Q. 11. What functions are being performed by Indian National Satellite (INSAT) ?

Ans. Functions performed by INSAT are :

(i) INSAT is being used for direct broadcasting of television programmes to remote areas of our country

(ii) INSAT is being used for long distance telephone calls.

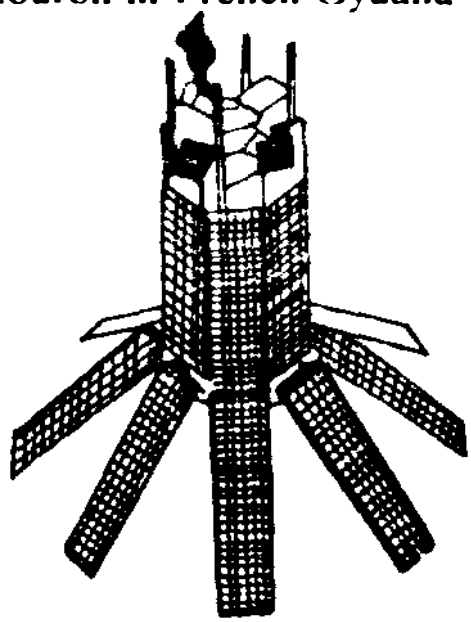
(iii) INSAT is being used for continuous weather monitoring and weather forecasting.

(iv) INSAT is being used for connecting all the radio stations and television stations of the country.

INSAT-1A which was launched on 4 September, 1982 failed in its mission. The INSAT-1B satellite was launched on 30 August 1983 with the help of U.S. space shuttle. It functioned extremely well for ever five years. The successful launching of INSAT-1B has paved the way for revolutioning communication system in India. The INSAT-1C ended to replace INSAT-1B was a failure. The INSAT-1D was put into a geostationary orbit in June 1990.

The first Indian built satellite INSAT-2A was successfully launched on 10 July, 1992 from Kouron in French Gyuana with the help of Ariane Rocket.

Q. 12. Give a brief account of the development of stretched Rohini satellites (SROSS).



Ans. The first attempt to launch SROSS-1 by ASLV on 24 March, 1987 was a failure. The Indian space science programme had another set back when second attempt to launch SROSS-2 by ASLV on

13 July 1988 also met with a failure. The historic event of launching of an Indian satellite on an Indian launch vehicle took place on 10 July, 1992. The launch vehicle was a 23 metre tall five stage solid-fuelled rocket ASLV-D3, a modified version of ASLV. It carried with it 106 kg SROSS-C satellite and placed it into an orbit 430 km above the earth. With this success India become the sixth nation in the world who has the capability of designing fabricating and launching a satellite in an earth orbit.

Q. 13. What are artificial satellites and give its uses?

Ans. Artificial satellites. The manmade objects placed in orbits in the outer space are called artificial satellites. These satellites which keeps orbiting around the earth in circular paths or elliptical paths, are called artificial earth satellites.

Uses of Artificial Satellites :

(i) They are used as a communication relay station for long distance telephone ratio and T.V. signals.

(ii) They are used as a weather observatory for making meteorological observations required for forecasting of weather on earth.

(iii) They are used as a base station for making astronomical observations.

(iv) They are used for surveying any part or area of the earth for natural resources like underground water, coal, oil, minerals and ores.

Q. 14. Discuss the use of satellites in weather monitoring.

Ans. At any place the conditions of the atmosphere do not remain the same for a long time. They are undergoing changes every hour. Air pressure, temperature, clouds, humidity, cyclones, rainfall are main atmospheric conditions. *The weather of a place is the variations in the atmospheric conditions of that place every hour. Weather monitoring* means to have the continuous knowledge of the various factors which constitute weather at a place. The branch of science in which

we study atmosphere and its phenomenon like weather and climate is called meteorology.

The satellites used to keep a continuous track of the various factors affecting weather at a place is called *Geostationary satellite*. This is the satellite orbitting in the equatorial plane at a height of 35,680 km from the earth. It remains fixed over a fixed point on the globe. Its period of revolution is 24 hours *i.e.*, equal to the period of rotation of the earth. INSAT-1B is India's geostationary satellite. It is being used for weather monitoring and weather forecasting.

To tell about the coming weather at a place in advance, is called *weather forecasting*. This is done with the help of weather satellites or geostationary satellites. These satellites are equipped with cameras to take pictures of the cloud formation in the atmosphere. These are also equipped with a large number of instruments which sense the weather conditions.

INSAT-1B has been sending pictures and other signals regularly after every half an hour since 1983. The meteorologists in our country analyse these pictures and signals and then forecast the changing weather conditions over our country (India). In the end of Hindi and English news on T.V. every evening, we can see the photos sent by INSAT-1B and hear the weather forecast on the basis of those pictures and other informations.

Q. 15. Give the principle of Satellite Communication.

Ans. There is an amplifier and a transmitter in the communication satellite. They work with solar energy. There is set up a net work of transmitting and receiving ground stations all over the country or all over the world. The T.V. waves, radio waves and radio telephone waves of very short wave-lengths, carrying news and messages or other programmes, are sent to the communication satellite from a particular station on the earth. The communication satellite after receiving the signals from the ground station amplifies them and then transmits them, to the various stations on the earth where they are again converted into

telephone talks or T.V. or radio programmes by the receivers. The electro-magnetic communication signals are sent to the communication satellite at one frequency and are received back from the satellite at another frequency. So these signals can be received at the station from where they are sent. In India the satellites of INSAT-1 series are being used as communication satellites. But our country has now started to launch INSAT-2 series also.

Q. 16. Discuss the use of satellites on remote sensing.

Ans. Remote sensing, in general, refers to collection of information about an object without physical contact with that object. Unlike geostationary satellites, the orbits of the satellites dedicated to remove sensing are such that the satellite passes over a particular latitude at approximately the same local time. In other words, it means that the position of the sun with respect to a point on the earth remains approximately same as the satellite passes over it. Such orbits are called sun-synchronous orbit. This enables remotes sensing satellites to take photographs of a particular region with nearly same illumination every time it passes through that region.

The data collected by Indian remote sensing satellites, IRS-IA and IRS-IB, has been used for many practical purposes. Some of these are forestry, preparing wasteland maps ; ground water surveys, agriculture, drought assessment, estimation of crop yields and detection of crop disease, and detection of potential fishing zones.

Q. 17. Give brief history of space exploration.

Ans. Russia launched the first man-made artificial satellite Sputnik-I into the space on October 4, 1957 with the aim of revealing the mysteries of the outer space. Thus, man stepped into the 'Space age' on October 4, 1957. Yuri Gagarin of U.S.S.R. was the first man to go into the space in a space-craft called Vostok-I in 1961. Alan Shepard of U.S.A. also went into space in a space craft in 1961. Alexei Leonov was the first man to under-

take space walk in October 1964.

U.S.A. launched a space-craft Surveyor-I on June 2, 1966 for making a soft landing on the moon. Surveyor-V, launched in September 1967, succeeded in chemically analysing the lunar soil. It reported oxygen and silicon are the most abundant elements on the moon.

Apollo-XI of U.S.A. was launched on July 16, 1969. It carried three astronauts – Neil Armstrong, Edwin Aldrin and Michael Collins into the space. Neil Armstrong became the first man to land on the moon on July 20, 1969. Edwin Aldrin also landed on the moon. Michael Collins stayed in the space-craft circling round the moon. The three astronauts safely retured to the earth.

Apollo-XVII took the astronauts to the moon in December 1972. They stayed there for 75 hours *i.e.* for the longest period so far.

Luna-26 of U.S.S.R. was launched on September 8, 1970. It was an unmanned space-craft. It landed on the moon and from there it brought the sample of lunar rock and dust to the earth.

U.S.S.R. launched various space ships called *Soyuz* under her space research programme.

U.S.A. launched Mariner-2 in 1967 for the exploration of planet Venus and Mariner-9 in 1971 for the exploration of planet Mars.

U.S.A. launched ERTS (Earth Research Technology Satellite) in 1972 with the aim of helping in agriculture, geography, geology, meteorology, oceanography etc.

U.S.A. sent Pioneer space-crafts in 1972 and Voyager space probes in 1977.

Q. 18. What are the aims of space exploration ?

Ans. The aims of space exploration were :

(i) To study the upper atmosphere.

(ii) To study about the planets and other objects, their

distance, temperature, atmosphere and to collect information regarding presence of life in the planets.

(iii) To collect information regarding temperature, density and composition of earth's atmosphere upto a height of about 1000 km.

(iv) To reach the moon and the near planets and to collect information about their temperature, atmosphere, presence of oxygen, presence of life etc.

(v) To study about Van Allen Radiation belts of electricity charged particles trapped in earth's magnetic field.

(vi) To establish satellite communication and weather monitoring for the following purposes :

(a) Long distance telephone facility.

(b) Director T.V. broadcasting.

(c) Weather forecasting.

(d) ERTS (Earth Resources Technology Satellite) launched by U.S.A. aimed to help research in agriculture, geology, geography, meteorology etc.

Q. 19. What were the early problems in space explorations ?

Ans. Early problems in space exploration. Space exploration includes the collection of information about the other planets of the solar system and outer space. The prime problem before the astronomers was the composition of the universe *i.e.*, the relative abundance of different species of atoms. The most abundant elements in the universe are thought to be the lighter ones, like hydrogen, helium, carbon, nitrogen, oxygen, neon etc. Unfortunately, their strongest spectral lines are in the far ultraviolet region of the radiation spectrum, which can never be observed from the surface of the earth.

Another important problem was the distribution of other systems of stars as one goes farther outward into space. Because of the apparent expansion of the universe at great distances the

red shift becomes larger and all the light of the system is shifted into the non-photographable far infrared.

But indirect methods using 'space probes' have given us some preliminary data. On 6th October, 1957 Russia has launched her **first sputnik** in space. **Yuri Gagarin was the first man** who went aroung the earth in an artificial satellite launched again by Russia on 12th April, 1961.

Q. 20. Discuss the history of space exploration of moon.

Ans. History of space exploration of moon. The moon is the only natural satellite of the earth, which revolves round the earth once in $27\frac{1}{3}$ days *i.e.*, its period of revolution is $27\frac{1}{3}$ days. Its mean distance from the earth is about $3{\cdot}85 \times 10^5$ km. Its mean diameter is about 3480 km, which is about $\frac{1}{4}$th that of the earth. Its mass is about $7{\cdot}35 \times 10^{22}$ kg, which is about $\frac{1}{80}$th that of the earth. Its density is about 3340 kg/m^3, which is about 0.6 times that of the earth. The value of acceleration due to gravity at moon is about 1.96 m/s^2, which is about $\frac{1}{3}$th that on the earth. The temperature of the moon during day time is 110°C and during nights is –150°C *i.e.*, moon is hot during day time and very cold during nights. The surface of the moon is not smooth, but is covered with jagged mountains, deep valleys and innumerable craters.

The following are the main observations based on space probe study :

(a) Luna-3, the Russian probe send in 1960 took the photographs of rear side of the moon. These photographs revealed that like front side, rear side of the moon also contains jagged mountains, deep valleys and innumerable craters.

(b) Unmanned space ships Surveyor and Orbiter were sent

by U.S.A. followed by manned Apollo-11 space vehicle on 20th July, 1969 along with astronaauts Armstrong, Addrin and Collins to observe the moon from close range. The astronauts were able 'walk' on the moon and brought with them samples of lunar soil and rocks.

(c) Unmanned robot vehicle Lunakhod was sent by Russians in January 1973, which also brought back samples of lunar soil and rocks.

A close examination and analysis of lunar material (soil and rocks etc.) showed that lunar rocks are similar to those of earth's crust and their age agrees with the age of the earth. It also showed that there is no atmosphere or water on moon. Rocks were found to be without vegetation, life and sound.

Q. 21. Discuss the history of space exploration of Venus.

Ans. History of space exploration of Venus. Venus is a brilliantly shining planet because it reflects about 85% of the sunlight falling on it. It is about $4 \cdot 2 \times 10^7$ km distant from the earth. Its radius, mass, density and surface gravity are nearly equal to that of the earth, and hence it may be called as twin of the earth. Its period of revolution is about 225 days. The temperature of its surface is about 480°C.

Two Russian space crafts Venus 9 and 10 sent during 1965-71, revealed that Venus was covered with thick atmosphere containing about 95% carbon dioxide. The surface pressure was found to be about 100 times that of atmospheric pressure. These conditions rule out any possibility of life on Venus.

Q. 22. Discuss the history of space exploration of Mercury.

Ans. History of space exploration of Mercury. Mercury is at a distance of about $9 \cdot 2 \times 10^7$ km from the earth. Its radius is about $2 \cdot 44 \times 10^3$ km, which is about $\frac{2}{5}$th that of earth and its mass is about 1/18th that of the earth. Its density is nearly equal

to that of earth, while surface gravity is about $\frac{2}{5}$th that on the earth. Its period of revolution is about 365 days. The temperature of its side facing the sun is about 370°C, while the other side is at about –249°C. It is found having no atmosphere and hence no life.

Photographs taken by Mariner 10 space ship launched by U.S.A. in February 1973 revealed that its surface has craters of all sizes just as that on the moon.

Q. 23. Discuss the history of space exploration of Mars.

Ans. History of space exploration of Mars. Mars is a reddish planet. It is at a distance of about $7{\cdot}8 \times 10^7$ km from the earth. Its radius is about $3{\cdot}39 \times 10^3$ km which is about hald that of the earth and its mass is about $\frac{1}{9}$th that of the earth. Its density is about $\frac{2}{3}$rd of that of the earth and surface gravity is about $\frac{2}{3}$rd that on the earth. Its period of revolution is about 687 days. Its temperature varies from about 30°C during day time to about –75°C at night. Since it has nearly earth like conditions, it may have some life. Mars exhibits white polar caps which grow large in winter.

Photographs taken by Mars vehicle sent by Russia and Mariner spacecraft sent by U.S.A. during 1971-72 showed that Mars has thin atmosphere mainly made up of carbon dioxide. White polar caps were also made up of solid carbon dioxide with traces of water in them. These photographs also showed that Mars has craters like those on the moon.

Viking-I and Viking-II were sent by U.S.A. on 20th July, 1976 and 3rd September, 1976. They sent valuable and remarkable data about Mars.

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